



Klamath River Renewal Project

Fall Creek Fish Hatchery— Technical Specifications

IFC Design Submittal

FINAL
Revision No. 00



October 2020

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**FALL CREEK FISH HATCHERY DESIGN
TECHNICAL SPECIFICATIONS**

**100% DESIGN
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SECTION 01 11 00 - SUMMARY OF WORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The WORK to be performed under this Contract shall consist of furnishing plant, tools, equipment, materials, supplies, and manufactured articles, and furnishing all labor, transportation, and services, including fuel, power, water, and essential communications, and performing all work or other operations required for the fulfillment of the Contract in strict accordance with the Contract Documents. The WORK shall be complete, and all work, materials, and services not expressly indicated or called for in the Contract Documents which may be necessary for the complete and proper construction of the WORK in good faith shall be provided by the CONTRACTOR as though originally so indicated, at no increase in cost to the OWNER.

1.2 WORK COVERED BY CONTRACT DOCUMENTS

- A. The WORK of this Contract comprises the construction of the following:
 - 1. A concrete intake structure on the southeast bank of Fall Creek adjacent to Dam A. The intake will divert up to 10 cfs from Fall Creek.
 - 2. A concrete apron downstream of Dam A to create a velocity fish barrier to preclude adult and juvenile fish.
 - 3. A concrete apron downstream of Dam B to create a velocity fish barrier to preclude adult and juvenile fish.
 - 4. A pre-engineered metal building (PEMB) Coho building to house Coho incubation, grow-out and rearing raceway infrastructure. Rehabilitate existing upper raceway structure concrete.
 - 5. Concrete Chinook Raceways that include fish screen guide slots and stop log slots along the length of the structure such that ponding volumes can be incremented based on fish development.
 - 6. PEMB Chinook Incubation building to house the chinook egg incubation operations.
 - 7. PEMB spawning building.
 - 8. Rehabilitate and construct new concrete walls in existing lower raceways to create the adult holding ponds.
 - 9. A Denil-type fish ladder.
 - 10. A concrete sill for installation of a temporary fish exclusion barrier during spawning operations.
 - 11. An earthen fish barrier berm to prevent fish passage during extreme flood events.

12. Portions of the WORK involve the installation of equipment and materials to be furnished by the OWNER.

- B. The WORK is located at the existing Fall Creek Fish Hatchery site located in Siskiyou County northwest of Iron Gate Dam near Yreka, California.

1.3 CONTRACT METHOD

- A. The WORK hereunder will be constructed under a single lump sum contract.

1.4 CONTRACTOR USE OF SITE

- A. The CONTRACTOR's use of the Site shall be limited to its construction operations, including on-Site storage of materials, and on-Site fabrication facilities.

1.5 OUTAGE PLAN AND REQUESTS

- A. Unless the Contract Documents indicate otherwise, the CONTRACTOR shall not remove from service, de-energize, or modify settings for any existing operating pipeline, tank, valve, channel, equipment, structure, road, or any other facility without permission from the ENGINEER.
- B. Where the WORK requires modifications to existing facilities or construction of new facilities and connection of new facilities to existing facilities, the CONTRACTOR shall submit a detailed outage plan and schedule for the ENGINEER'S approval a minimum of two (2) weeks in advance of the time that such outage is planned.
- C. The ENGINEER shall be notified in writing at least one week in advance of the required outage if the schedule for performing the work has changed or if revisions to the outage plan are required.
- D. The CONTRACTOR shall provide written confirmation of the shutdown date and time two (2) working days prior to the actual shutdown.

1.6 PROJECT MEETINGS

A. **Preconstruction Conference**

1. Prior to the commencement of WORK at the Site, a preconstruction conference will be held at a mutually agreed time and place. The conference shall be attended by the CONTRACTOR'S Project Manager, its superintendent, and its subcontractors as the CONTRACTOR deems appropriate. Other attendees will be:
 - a. ENGINEER and the Resident Project Representative.
 - b. Representatives of OWNER.
 - c. Governmental representatives as appropriate.
 - d. Others as requested by CONTRACTOR, OWNER, or ENGINEER.

2. The CONTRACTOR shall bring the preconstruction conference submittals in accordance with Section 01 33 00 - Contractor Submittals.
3. The purpose of the conference is to designate responsible personnel and establish a working relationship. Matters requiring coordination will be discussed and procedures for handling such matters established. The complete agenda will be furnished to the CONTRACTOR prior to the meeting date. However, the CONTRACTOR should be prepared to discuss all of the items listed below.
 - a. Status of CONTRACTOR's insurance and bonds.
 - b. CONTRACTOR's tentative schedules.
 - c. Transmittal, review, and distribution of CONTRACTOR's submittals.
 - d. Processing applications for payment.
 - e. Maintaining record documents.
 - f. Critical work sequencing.
 - g. Detailed outage plan.
 - h. Field decisions and Change Orders.
 - i. Use of Site, office and storage areas, security, housekeeping, and OWNER's needs.
 - j. Major equipment deliveries and priorities.
 - k. CONTRACTOR's assignments for safety and first aid.
 - l. Daily Report Form which the ENGINEER will furnish.
 - m. Submittal Transmittal Form which the ENGINEER will furnish.
4. The ENGINEER will preside at the preconstruction conference and will arrange for keeping and distributing the minutes to all persons in attendance.
5. The CONTRACTOR and its subcontractors should plan on the conference taking no less than two (2) full working days. The first day will cover the items listed in paragraphs 2 and 3, and the following day(s) will be spent on reviewing the Drawings and Specifications, in extensive detail, with the ENGINEER and the OWNER.

B. Progress Meetings

1. The ENGINEER will schedule and hold regular on-Site progress meetings at least weekly and at other times as requested by CONTRACTOR or as required by progress of the WORK. The CONTRACTOR, ENGINEER, and all subcontractors active on the Site shall attend each meeting. CONTRACTOR may at its discretion

request attendance by representatives of its suppliers, manufacturers, and other subcontractors.

2. The ENGINEER will preside at the progress meetings and will arrange for keeping and distributing the minutes. The purpose of the meetings is to review the progress of the WORK, maintain coordination of efforts, discuss changes in scheduling, and resolve other problems which may develop. During each meeting, the CONTRACTOR shall present any issues that may impact its progress with a view to resolve these issues expeditiously.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 12 00 - HYDROLOGY AND HYDRAULICS

PART 1 -- GENERAL

1.1 OVERVIEW

- A. This Section describes: the hydrologic data at the site and the typical operations of the Fall Creek powerhouse and City of Yreka intake structures.
- B. This Section is provided for information only and does not guarantee specific hydrology or hydraulics.

1.2 FALL CREEK POWERHOUSE OPERATIONS

- A. The Fall Creek Powerhouse is located approximately 0.8 miles upstream from the mouth of Fall Creek at Iron Gate Reservoir and directly upstream from the Project site. PacifiCorp operates a set of dams and canals on Spring Creek and Fall Creek to divert a maximum of 50 cubic feet per second (cfs) to the powerhouse. The powerhouse discharges to a constructed tailrace canal that discharges to Fall Creek at the north end of the Project site.
- B. The current license for the Fall Creek powerhouse requires that 15 cfs or the natural stream flow (whichever is less) be maintained downstream of the powerhouse.

1.3 DEFINITIONS

- A. In-Water Work (IWW): Work that is performed within the limits of the Ordinary High Water Mark (OHWM), as defined on the Contract Drawings. This definition does not imply that work outside of the OHWM will not be impacted by extreme events. Some areas not designated IWW are within the channel floodplain.

1.4 CITY OF YREKA INTAKE OPERATIONS

- A. The City of Yreka maintains two diversions that supply the City's drinking water: (1) Dam A and (2) Dam B.
 - 1. Dam A is located on the powerhouse tailrace canal and has a typical crest elevation of 2510.4 feet (Vertical Datum NAVD88, Geoid 12B). There exists on Dam A a flashboard spillway with invert elevation 2507.4 ft (NAVD88), and a sluice gate at elevation 2506.0 ft (NAVD88). Adjacent to Dam A, on the west bank of the tailrace canal, is located the City of Yreka intake structure, which consists of a set of screens and a 24" diameter water main (invert elevation 2505.15 ft NAVD88) that conveys water to the City of Yreka.
 - 2. Dam B is located on Fall Creek, approximately 300 ft upstream of the confluence with the powerhouse canal and the Project site. Dam B has a crest elevation of 2513.4 ft (NAVD88) and has two (2) x five-foot-wide flashboard slots. The intake structure is located on the south bank of the creek and consists of a set of screens and a 24" diameter conveyance pipe (invert elevation 2506.9 ft NAVD88) that

conveys water across the creek to the Dam A impoundment, adjacent to the Dam A intake.

- B. The City of Yreka maintains a 15 cfs consumptive water right. If flows are insufficient in the powerhouse canal, the Dam B intake is operated to convey make-up flows from Fall Creek to the Dam A impoundment, where water is then diverted to the City.

1.5 AREAS FOR IN-WATER WORK (IWW)

- A. There exist five locations as part of the Work defined for this Project for which IWW is expected:
 - 1. Dam A – Work in the powerhouse canal is expected at and around Dam A for the construction of the hatchery intake, and for the construction of the velocity barrier modifications to Dam A.
 - 2. Dam B – Work in Fall Creek is expected at Dam B for the construction of the velocity barrier modifications to Dam B.
 - 3. Existing Flume Demolition – Work in the powerhouse canal is expected at the existing concrete flume for demolition and backfill work.
 - 4. Chinook Fish Release Pool – Work in Fall Creek is expected for installation of the fish release pipe, and construction and earthworks associated with the outlet pool. This will be located as indicated on the Contract Drawings.
 - 5. Fish Barrier and Fishway – Work in Fall Creek is expected for the construction of the fish barrier and fishway and appurtenant earthworks and concrete construction. This will be located at the downstream limits of the Project.

1.6 COFFERDAM AND DESIGN WATER LEVELS DURING CONSTRUCTION

- A. The cofferdam design shall be per Specification Section 02 15 00 – Cofferdam and Protective Works.
- B. CONTRACTOR shall take into account the below design and overflow levels in planning and scheduling construction activities. Provisions for all cofferdams shall be CONTRACTOR's responsibility.

1.7 PROJECT HYDROLOGY RECORDS

- A. The U.S. Geological Survey (USGS) maintained a stream monitoring gage (USGS Gage No. 11512000) located on Fall Creek approximately 2/3 miles downstream from the Project site. The data record associated with this gage extends from 1933 to 1959, and from 2003 to 2005. This is the best available stream flow information for the site.
- B. Table 01 12 00 – 01 presents a summary of the maximum, 5%, 50%, 95% exceedance, and minimum flows per month and annually. The low flow period is from May to November. The high flow period is from December to April. January and February typically see the highest flows, and August sees the lowest flows.

Table 01 12 00 – 01. Flow Summary

Flow (cfs)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Minimum	28	27	29	28	25	24	23	21	22	27	26	28	21
95% Exceedance	28	30	33	30	28	27	25	25	25	28	29	29	27
50% Exceedance	41	44	48	43	36	33	32	31	33	34	37	38	36
5% Exceedance	82	93	81	69	55	49	45	46	46	48	54	69	63
1% Exceedance	165	142	92	85	62	57	50	47	47	52	62	150	92
Maximum	249	200	130	187	65	58	52	47	52	77	137	474	474

C. The 15 largest floods of record are listed in Table 01 12 00 – 02.

Table 01 12 00 – 02. Flood of Records, 1933 – 1959 and 2003 - 2005

Date	Peak Flow (cfs)
12/22/1955	474
1/15/1956	249
12/21/1955	247
1/10/1936	245
12/23/1955	244
1/28/1958	219
1/29/1958	219
12/27/1942	213
12/11/1937	200
2/21/1956	200
1/4/1946	198
1/7/1948	193
1/18/1953	188
4/13/1937	187
1/2/1936	178

- D. The 100-year flow at the USGS gage station was collected from the USGS based on the 28-year gage data. The 100-year flow at the USGS gage station, approximately 2/3 miles downstream of the Project site is 905 cfs.
- E. The ordinary high-water mark (OHWM) is defined as the point on a stream bank at which the presence and action of surface water is so continuous as to leave a distinct erosion mark, destruction or prevention of woody terrestrial vegetation, predominance of aquatic vegetation, or other easily recognized characteristics. Therefore, the OHWM defines the jurisdictional boundary between upland and riparian areas subject to permitting requirements. The OHWM is often defined as the 2-year flood elevation. To obtain the 2-year flood elevation, the USGS defined 2-year flood was collected for the USGS gage 11512000. The 2-year recurrence interval peak flow is about 138 cfs. This can be used to determine the OHWM at the various locations of IWW.

1.8 WATER SURFACE ELEVATIONS

- A. Water surface elevations as depicted in the Contract Drawings are for reference with regards to fish passage characteristics and design flood events. They do not represent monthly or annual exceedance probabilities but are defined based on fish passage requirements. The CONTRACTOR should not use the water surface elevations or flow rates as depicted in the Contract Drawings, but rather the information presented in this Specification, for reference.
- B. Water surface elevations at the locations of IWW will be impacted by the CONTRACTOR's use of cofferdam systems, protective works, dewatering and bypass infrastructure, and construction staging. Therefore, predictions of design water surface levels cannot be accurately made prior to the development of cofferdam and dewatering plans, and it shall be incumbent upon the CONTRACTOR to perform calculations and make determinations regarding the design water surface levels during construction. Hydrologic data has been provided to aid the CONTRACTOR in making such determinations.

1.9 AREA WEATHER

- A. Precipitation and Temperature records were collected from the nearby NOAA station in Montague, CA at the Siskiyou Airport, and are provided below for the CONTRACTOR's reference.
- B. Precipitation varies throughout the year with the highest average monthly precipitation during November and the lowest during August. The average rainfall in the Montague, CA for each month is listed in Table 01 12 00 – 05.

Table 01 12 00 – 05. Average Precipitation and Temperature Records

Month	Precipitation (inches)	Temperature (°F)	
		High	Low
January	2.2	45	26
February	2.0	51	28
March	2.3	56	30
April	1.6	61	33
May	1.4	72	40
June	0.7	80	47
July	0.5	91	54
August	0.3	90	52
September	0.6	81	43
October	1.2	68	36
November	3.0	50	29
December	2.7	44	26

- C. Temperature and other weather conditions at the site vary throughout the year and should be carefully factored into the construction work. CONTRACTOR shall comply with all applicable cold weather construction practices and requirements.

1.10 CONSTRUCTION LIMITATION

- A. Construction activities must not impede the City of Yreka obtaining its full water right of 15 cfs throughout the entire construction period.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 CONSTRUCTION PLANNING AND SCHEDULING

- A. CONTRACTOR shall take account the above described hydrology, hydraulic design, and weather conditions when planning and scheduling all construction activities. CONTRACTOR shall ensure the work is carried out in a safe manner, protected from damage, and in accordance with standard accepted construction practice.

- END OF SECTION -

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SECTION 01 29 00 - SCHEDULE OF VALUES

PART 1 -- GENERAL

1.1 GENERAL

- A. This Section defines the process whereby the Schedule of Values (lump sum price breakdown) shall be developed and incorporated into the cost loading function of the CPM Schedule per Section 01 32 15 – CPM Construction Schedule. Monthly progress payment amounts shall be determined from the monthly progress updates of the CPM Schedule activities.
- B. The Schedule of Values shall be developed independent but simultaneous with the development of the CPM Schedule activities and logic.

1.2 PRELIMINARY SCHEDULE OF VALUES

- A. The CONTRACTOR shall submit a preliminary Schedule of Values for the major components of the WORK at the Preconstruction Conference in accordance with Section 01 11 00 - Summary of Work. The listing shall include, at a minimum, the proposed value for the following major WORK components:

- 1. Mobilization
- 2. The total value of electrical WORK.
- 3. The total value of Instrumentation and Control WORK.
- 4. The total value of Protective Coatings WORK.
- 5. The total value of yard mechanical WORK inclusive of excavation, pipe installation, testing and backfill of pipe, and all incidental WORK associated with underground pipe installations.
- 6. The total value of mechanical WORK, exclusive of yard mechanical WORK included in Item 5 above. This includes piping, valves, equipment, tanks, and appurtenances at new and existing structures. Additionally, this total value shall be broken down into separate values for each new and existing structure constructed or modified as a part of the WORK.
- 7. The total value of structural reinforced concrete WORK inclusive of excavation, dewatering, subgrade preparation, backfill and incidental WORK for new structures. Additionally, this total value shall be broken down into separate values for each new structure constructed as a part of the WORK. Miscellaneous and minor concrete WORK may be listed as one item in this breakdown.
- 8. The total value of pre-engineered metal buildings, inclusive of architectural WORK, doors, windows and other incidental systems and features. Additionally, this total value shall be broken down into separate values for each pre-engineered metal building.

9. The total value of site civil WORK inclusive of clearing and grubbing, paving, grading and drainage WORK.

10. The total value of other WORK not specifically included in the above items.

- B. The CONTRACTOR and ENGINEER shall meet and jointly review the preliminary Schedule of Values and make any adjustments in value allocations if, in the opinion of the ENGINEER, these are necessary to establish fair and reasonable allocation of values for the major WORK components. Front end loading will not be permitted. The ENGINEER may require reallocation of major WORK components from items in the above listing if in the opinion of the ENGINEER such reallocation is necessary. This review and any necessary revisions shall be completed within 15 Days from the date of Notice to Proceed.

1.3 DETAILED SCHEDULE OF VALUES

- A. The CONTRACTOR shall prepare and submit a detailed Schedule of Values to the ENGINEER within 30 Days from the date of Notice to Proceed. The detailed Schedule of Values shall be based on the accepted preliminary Schedule of Values for major WORK components. Because the ultimate requirement is to develop a detailed Schedule of Values sufficient to determine appropriate monthly progress payment amounts through cost loading of the CPM Schedule activities, sufficient detailed breakdown shall be provided to meet this requirement. The ENGINEER shall be the sole judge of acceptable numbers, details and description of values established. If, in the opinion of the ENGINEER, a greater number of Schedule of Values items than proposed by the CONTRACTOR is necessary, the CONTRACTOR shall add the additional items so identified by the ENGINEER.

1. The minimum detail of breakdown of the major WORK components is indicated below. Greater detail shall be provided if requested by the ENGINEER.

- a. Mobilization - no breakdown required.
- b. Section 01 32 15 - CPM Construction Schedule, broken down by submittal.
- c. The electrical WORK shall be broken down by structure and yard facilities. Structures electrical WORK shall be broken down into conduit and raceway installation, cable and wire installation, electrical equipment installation, terminations and lighting. Yard facilities shall be broken down by duct bank designation and substations.
- d. Instrumentation and Control WORK shall be broken down by structure.
- e. Protective Coating WORK shall be broken down by structure and yard area. Where specific coating WORK at structures or yard areas may be critical to performing the WORK to meet milestone and Contract Times, such WORK shall be included as individual pay and Schedule activity items.
- f. Yard piping WORK shall be broken down into individual pipelines running from and to Contract termination points. Each pipeline shall be an individual pay item unless otherwise allowed by the ENGINEER.

- g. Mechanical WORK shall be broken down within each structure to identify individual piping systems, equipment installation by equipment name and number, and equipment testing and checkout.
 - h. Concrete structures shall be broken down into excavation, subgrade preparation, and appurtenant prefoundation WORK, concrete foundation construction, slabs on grade, walls/columns, suspended slabs, stairs, etc. (sufficient breakdown shall be provided to accommodate necessary Schedule detail), hydrostatic structure testing where required and backfill.
 - i. Pre-engineered metal buildings shall be broken down into building frame erection, roofs, decks, siding and soffit WORK, insulation, doors/windows/louvers, and any other items determined to be necessary for establishment of pay and Schedule activity items.
 - j. Civil site WORK shall be broken down into individual drainage piping, drainage structures, site concrete, paving, excavation cut and fill, removal of existing pipe, clearing and grubbing and any other items determined to be necessary for the establishment of Pay and Schedule Activity items.
 - k. Pre-commissioning and commissioning broken down for completion milestones for each.
 - l. Other WORK not specifically included in the above items shall be broken down as necessary for establishment of pay and Schedule activity items.
2. The CONTRACTOR and ENGINEER shall meet and jointly review the detailed Schedule of Values within 35 Days from the date of Notice to Proceed. The value allocations and extent of detail shall be reviewed to determine any necessary adjustments to the values and to determine if sufficient detail has been proposed to allow acceptable cost loading of the CPM Schedule activities. Any adjustments deemed necessary to the value allocation or level of detail shall be made by the CONTRACTOR and a revised detailed Schedule of Values shall be submitted within 40 Days from the date of Notice to Proceed.
3. Following acceptance of the detailed Schedule of Values, the CONTRACTOR shall incorporate the values into the cost loading portion of the CPM Schedule. The CPM activities and logic shall have been developed concurrent with development of the detailed Schedule of Values; however, it shall be necessary to adjust the detailed Schedule of Values to correlate to individual Schedule activities. It is anticipated that instances will occur, due to the independent but simultaneous development of the Schedule of Values and the CPM Schedule activities, where interfacing these 2 documents will require changes to each document. Schedule activities may need to be added to accommodate the detail of the Schedule of Values. Schedule of Value items may need to be added to accommodate the detail of the CPM Schedule activities. Where such instances arise, the CONTRACTOR shall propose changes to the Schedule of Values and to the CPM Schedule activities to satisfy the CPM Schedule cost loading requirements.

1.4 CROSS REFERENCE LISTING

- A. To assist in the correlation of the Schedule of Values and the CPM Schedule, the CONTRACTOR shall provide a Cross Reference Listing which shall be furnished in 2 parts. The first part shall list each Scheduled Activity with the breakdown of the respective valued items making up the total cost of the activity. The second part shall list the valued item with the respective Scheduled Activity or Activities that make up the total cost indicated. In the case where a number of schedule items make up the total cost for a valued item (shown in the Schedule of Values) the total cost for each scheduled item should be indicated.
- B. These listings shall be updated and submitted in conjunction with the CPM monthly submittals as stated in Specification Section 01 32 15.
- C. Approved change orders reflected in the CPM Schedule shall be incorporated into the Schedule of Values as a single unit identified by the change order number.

1.5 CHANGES TO SCHEDULE OF VALUES

- A. Changes to the CPM Schedule which add activities not included in the original schedule but included in the original WORK (schedule omissions) shall have values assigned as approved by the ENGINEER. Other activity values shall be reduced to provide equal value adjustment increases for added activities as approved by the ENGINEER.
- B. In the event that the CONTRACTOR and ENGINEER agree to make adjustments to the original Schedule of Values because of inequities discovered in the original accepted detailed Schedule of Values, increases and equal decreases to values for activities may be made.

1.6 LIQUIDATED DAMAGES

- A. The Schedule of Values information is an integral part of the scheduling and reporting under Section 01 32 15 and the progress payment information. As such, it is critical information to evaluating progress and the proper planning of the OWNER's and ENGINEER's WORK-related effort as well as their financial obligations associated with this project. Accordingly, if any submittal required by this Section is found to be incomplete or is submitted later than required, the OWNER will suffer financial loss and, accordingly, liquidated damages will be assessed against the CONTRACTOR in accordance with Article 3 of the Agreement.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 32 15 - CPM CONSTRUCTION SCHEDULE

PART 1 -- GENERAL

1.1 GENERAL

- A. The CONTRACTOR shall schedule the WORK in accordance with this Section.
- B. Development of the schedule, monthly payment requisitions and project status reporting requirements of the Contract shall employ computerized Critical Path Method (CPM) scheduling.
- C. The CPM schedule and related reports should be prepared with the current version of **Primavera Project Planner**, or other project planning software as approved by Engineer.

1.2 DEFINITIONS

- A. **CPM Scheduling:** The term shall be interpreted to be generally as outlined in the Association of General Contractors (AGC) publication, "The Use of CPM in Construction." except that either "i-j" arrow diagrams or precedence diagramming format may be utilized. In the case of conflicts between this Section and the AGC document, this Section shall govern.
- B. **Float:** Unless otherwise indicated herein, float and total float are synonymous. Total float is the period of time measured by the number of Days each non-critical path activity may be delayed before it and its succeeding activities become part of the critical path. If a non-critical path activity is delayed beyond its float period, then that activity becomes part of the critical path and controls the end date of the WORK. Thus, delay of a non-critical path activity beyond its float period will cause delay to the project itself.

1.3 SCHEDULING QUALIFICATION SUBMITTALS

- A. CONTRACTOR shall submit a statement of computerized CPM capability within 10 Days after Notice to Proceed to verify that either: (1) the CONTRACTOR has in-house capability qualified to use CPM techniques and the **Primavera** or other project planning software or (2) that the CONTRACTOR will arrange for the services of a CPM consultant so qualified. In either event the statement shall identify the individual who will perform the CPM scheduling and shall describe the construction projects required below. The statement shall also identify the contact persons for the referenced projects with current telephone and address information.
- B. **Criteria:** The individual performing scheduling shall have successfully applied computerized CPM technique to at least two (2) projects of similar nature, scope, and value not less than one half the Total Bid Price of this project.

1.4 INITIAL SCHEDULE SUBMITTALS

- A. Where submittals are required hereunder, the CONTRACTOR shall submit four (4) copies of each submittal item.

- B. The CONTRACTOR shall submit two (2) schedule documents at the Preconstruction Conference which serve as the CONTRACTOR's plan of operation for the initial 60 Day period of the Contract Times and identify the manner in which the CONTRACTOR intends to complete the WORK within the Contract Times.
1. 60 Day Plan of Operation: During the initial 60 Days of the Contract Times, the CONTRACTOR shall conduct operations in accordance with a 60 Day bar chart type schedule. The chart so prepared shall show accomplishment of the CONTRACTOR's early activities (mobilization, permit acquisition, submittals necessary for early material and equipment procurement, submittals necessary for long lead equipment procurement, CPM submittals, initial sitework and other submittals and activities required in the first 60 Days).
 2. Project Overview Bar Chart: The overview bar chart shall indicate the major components of the WORK and the sequence relations between major components and subdivisions of major components. The overview bar chart shall indicate the relationships and time frames in which the various components of the WORK will be made substantially complete and placed into service in order to meet the required milestones. Sufficient detail shall be included to subdivide major components in such activities as (1) excavation, (2) foundation subgrade preparation, (3) foundation concrete, (4) completion of structural concrete, (5) major mechanical WORK, (6) major electrical WORK, (7) instrumentation and control WORK, and (8) other important WORK for each major facility within the overall project scope. Planned durations and start dates shall be indicated for each WORK item subdivision. Each major component and subdivision component shall be accurately plotted on time scale sheets not to exceed 36-inches by 60-inches in size. No more than 4 sheets shall be employed to present this overview information.
- C. The ENGINEER and the CONTRACTOR shall meet to review and discuss the 60 Day plan of operation and project overview bar chart within five (5) Days after submittal to the ENGINEER. The ENGINEER's review and comment on the schedules will be limited to conformance with the sequencing and milestone requirements in the Contract Documents. The CONTRACTOR shall make corrections to the schedules necessary to comply with the requirements and shall adjust the schedules to incorporate any missing information requested by the ENGINEER.

1.5 CPM SCHEDULE SUBMITTALS

- A. **Original CPM Schedule Submittal:** Within 45 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall submit for review by the ENGINEER a hard copy of the CPM schedule and the computerized schedule report tabulations. The CONTRACTOR shall also submit a CD that contain the schedule submittal information. The data shall be compatible with **Primavera** or other project scheduling software to generate network diagrams and schedule reports identical to the hard copies submitted. This submittal shall have already been reviewed and approved by the CONTRACTOR's Project Manager, superintendent, and estimator prior to submission. The CPM schedule shall be a time-scaled network diagram of the "i-j" activity-on-arrow or precedence type. The network diagram shall describe the activities to be accomplished and their logical relationships and shall show the critical path.
- B. The computerized schedule report tabulations shall include the following:

1. Report of activities sorted by activity number: Activity numbers, where practical, shall correlate to the area numbers designated on the Contract Drawings as further defined in Section 01 11 00 - Summary of Work.
2. Report of activities sorted by early start date.
3. Report of activities sorted by total float.
4. Report of activities sorted by responsibility code. Responsibility codes shall be established for the CONTRACTOR, ENGINEER, OWNER, Subcontractors, Suppliers, etc. These codes shall be identified in the Network Diagram.
5. A successor-predecessor report which shall identify the successor and predecessor activities for each activity and ties between schedule activities.

C. Analysis

1. Early Completion
 - a. The CONTRACTOR may show early completion on the original CPM submittal if that is its plan.
 - b. An original CPM submittal showing early completion shall either be accompanied by:
 - 1) Request for change of Contract Times at zero change of Contract Price, accompanied by documentation demonstrating that the Bid was based on early completion, or
 - 2) Demonstration in the submittal that the time difference between early completion and the original Contract Time is total float.
 - c. An early completion schedule unaccompanied by one of these will not be accepted.
 - d. The ENGINEER will analyze a request for Change Order in accordance with the General Conditions.
2. Float Ownership: Neither the OWNER nor the CONTRACTOR owns the float time. The project owns the float time. Liability for delay to the project completion date rests with the party causing the delay. For example, if Party A is responsible for consuming a portion of the float time and Party B later consumes the remainder of the float time plus additional time beyond the float time, Party B is responsible for the time that is a delay past the completion date. Party A would not be responsible for any delay since it did not consume all the float time, additional float time remained after its delay, and the completion date was unaffected by its tardiness.

- D. Original CPM Schedule Review Meeting:** The CONTRACTOR shall, within 55 Days from the commencement date stated in the Notice to Proceed, meet with the ENGINEER to review the original CPM schedule submittal. The CONTRACTOR shall have the Project Manager, superintendent, and the scheduler in attendance. The meeting will

take place over a two (2) Day period. The ENGINEER's review will be limited to conformance with the Contract Documents. However, the review may also include:

1. Clarifications of the design intent.
2. Directions to include activities and information missing from the submittal.
3. Requests to the CONTRACTOR to clarify and revise the schedule.

E. Revisions to the Original CPM Schedule: Within 65 Days after the commencement date stated in the Notice to Proceed, the CONTRACTOR shall revise the original CPM schedule submittal to address review comments from the original CPM schedule review meeting and resubmit the network diagrams and reports for the ENGINEER's review. The ENGINEER, within 14 Days from the date that the CONTRACTOR submitted the revised schedule will either (1) accept the schedule as submitted, or (2) advise the CONTRACTOR in writing to review any part or parts of the schedule which either do not meet the requirements or are unsatisfactory for the ENGINEER to monitor the progress and status of WORK or evaluate monthly payment requests by the CONTRACTOR. The ENGINEER may accept the schedule conditional upon the first monthly CPM schedule update correcting deficiencies identified. When the schedule is accepted, it shall be considered as the "Original CPM Construction Schedule" until an updated schedule has been submitted. The ENGINEER reserves the right to require that the CONTRACTOR adjust, add to, or clarify any portion of the schedule which may later be discovered to be insufficient for the monitoring of WORK or approval of partial payment requests. No additional compensation will be provided for such adjustments, additions, or clarifications.

F. Acceptance

1. Acceptance of the CONTRACTOR's schedule by the ENGINEER and OWNER will be based solely upon compliance with the requirements. By way of the CONTRACTOR assigning activity durations and proposing the sequence of the WORK, the CONTRACTOR agrees to utilize sufficient and necessary management and other resources to perform WORK in accordance with the schedule. Upon submittal of a schedule update, the updated schedule shall be considered the "current" project schedule.
2. Submission of the CONTRACTOR's progress schedule to the ENGINEER shall not relieve the CONTRACTOR of total responsibility for scheduling, sequencing, and pursuing the WORK to comply with the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed WORK.

G. Monthly Updates and Periodic CPM Schedule Submittals

1. Following acceptance of the CONTRACTOR's original CPM schedule, the CONTRACTOR shall monitor the progress of the WORK and adjust the schedule each month to reflect actual progress and any changes in planned future activities. Each schedule update submittal shall be complete including information requested in the original schedule submittal and be in the schedule report format indicated below. Each update shall continue to show WORK activities including those already

completed. Completed activities shall accurately depict "as built" information by indicating when the WORK was actually started and completed.

2. Neither the submission nor the updating of the CONTRACTOR's original schedule submittal nor the submission, updating, change, or revision of any other report, curve, schedule, or narrative submitted by the CONTRACTOR, nor the ENGINEER's review or acceptance of any such report, curve, schedule, or narrative shall have the effect of amending or modifying in any way the Contract Times or milestone dates or of modifying or limiting in any way the CONTRACTOR's obligations under the Contract. Only a signed, fully executed Change Order can modify contractual obligations.
3. The monthly schedule update submittal will be reviewed with the CONTRACTOR during a monthly construction progress meeting held on the 20th Day of each month. The goal of these meetings is to enable the CONTRACTOR and the ENGINEER to initiate appropriate remedial action to minimize any known or foreseen delay in completion of the WORK and to determine the amount of WORK completed since the last schedule update. The status of the WORK will be determined by the percent complete of each activity in the updated CPM schedule. These meetings are considered a critical component of the overall monthly schedule update submittal, and the CONTRACTOR shall have appropriate personnel attend. As a minimum, the CONTRACTOR's Project Manager and superintendent shall attend these meetings. The CONTRACTOR shall plan on the meeting taking no less than 6 hours. Within 7 Days after the monthly progress meeting, the CONTRACTOR shall submit the revised CPM schedule, the revised CPM computerized tabulations, the revised successor/predecessor report, the project status reports as defined below and the CONTRACTOR's Application for Payment. Within 5 Days of receipt of the revised submittals, the ENGINEER will either accept or reject the monthly schedule update submittal. If accepted, the percent complete in the monthly update shall be the basis for the Application for Payment to be submitted by the CONTRACTOR. If rejected, the update shall be corrected and resubmitted by the CONTRACTOR before the Application for Payment for the update period will be processed.

- H. **Schedule Revisions:** The CONTRACTOR shall highlight or otherwise identify changes to the schedule logic or activity durations made from the previous schedule. The CONTRACTOR shall modify any portions of the CPM schedule which become infeasible because activities are behind schedule or for any other valid reason.

1.6 CHANGE ORDERS

- A. Upon approval of a Change Order or upon receipt by the CONTRACTOR of authorization to proceed with additional WORK, the change shall be reflected in the next submittal of the CPM Schedule. The CONTRACTOR shall utilize a sub-network in the schedule depicting the changed WORK and its effect on other activities. This sub-network shall be tied to the main network with appropriate logic so that a true analysis of the critical path can be made. Whenever the CONTRACTOR believes that a Change Order will extend the Contract Times, the sub-network analysis herein shall be submitted with the price proposal for the change. If the CONTRACTOR does not submit the sub-network demonstrating that the change affects the Contract Times, then no subsequent claim for additional time due to the change will be accepted.

1.7 CPM STANDARDS

- A. **Construction Schedules:** Construction schedules shall include a graphic network diagram and computerized schedule reports as required below for status reporting.
- B. **Networks:** The CPM network shall be in a form of a time scaled "i-j" activity-on-arrow or precedence type diagram and may be divided into a number of separate sheets with suitable match lines relating the interface points among the sheets. Individual sheets shall not exceed 36-inches by 60-inches.
- C. Construction and procurement activities shall be presented in a time-scaled format with a calendar timeline along the entire sheet length. Each activity arrow or node shall be plotted so that the beginning and completion dates of each activity are accurately represented along the calendar timeline. Every activity shall use symbols that clearly distinguish between critical path activities, non-critical activities, and free float for each non-critical activity. Activity items shall be identified by their activity number, responsibility code, duration, and dollar value. Non-critical path activities shall show total float time in scale form by utilizing a dotted line or some other graphical means.
- D. **Duration Estimates:** The duration estimate for each activity shall be computed in Days and shall represent the single best estimate considering the scope of the WORK and resources planned for the activity. Except for certain non-labor activities such as curing of concrete or delivery of materials, activity duration shall not exceed 10 Days nor be less than one Day, unless otherwise accepted by the ENGINEER.

1.8 SCHEDULE REPORT FORMAT

- A. **Schedule Reports:** Schedule reports shall be prepared based on the CPM schedule, shall be submitted on paper and floppy disk or CD, depending on file size, and shall include the following minimum data for each activity:
 - 1. Activity numbers and responsibility codes.
 - 2. Work Order No.
 - 3. CIP No.
 - 4. Estimated activity duration.
 - 5. Activity description.
 - 6. Activity percent completion.
 - 7. Early start date (calendar dated).
 - 8. Early finish date (calendar dated).
 - 9. Late start date (calendar dated).
 - 10. Late finish date (calendar dated).
 - 11. Status (whether critical).

12. Total float for each activity.

13. Free float for each activity.

B. **Project Information:** Each Schedule Report shall be prefaced with the following summary data:

1. Project name.
2. CONTRACTOR name.
3. Type of tabulation.
4. Project duration.
5. Contract Times (as revised by Change Orders).
6. The commencement date stated in the Notice to Proceed.
7. The data date and plot date of the CPM Schedule.
8. If an update, cite the new schedule completion date.

1.9 PROJECT STATUS REPORTING

- A. The CONTRACTOR shall furnish monthly project status reports (overview bar chart and a written narrative report) in conjunction with the revised CPM schedules as indicated above. Status reporting shall be in the form below.
- B. The CONTRACTOR shall prepare and submit monthly an overview bar chart schedule of the major project components. The overview bar chart schedule shall be a summary of the current CPM schedule (original and as updated and adjusted throughout the entire construction period). The major project components shall be represented as time bars which shall be subdivided into various types of WORK including demolition, excavation and earthwork, yard piping, concrete construction, and mechanical, electrical and instrumentation installations. Major components shall include each new structure by area designation, sitework, modifications to existing structures, tie-ins to existing facilities, and plant startups.
- C. Each major component and subdivision shall be accurately plotted consistent with the project overview bar chart above. It shall represent the same status indicated by early start and finish activity information contained in the latest update of the CPM schedule. In addition, a percent completion shall be indicated for each major component and subdivision. The initial submittal of the overview bar chart schedule shall be made at the time that the revised original CPM schedule is submitted to the ENGINEER. The CONTRACTOR shall amend the overview schedule to include any additional detail required by the ENGINEER. The CONTRACTOR shall include any additional information requested by the ENGINEER at any time during the construction of the WORK.

- D. The CONTRACTOR shall prepare monthly written narrative reports of the status of the project for submission to the ENGINEER. Status reports shall include:
1. The status of major project components (percent complete, amount of time ahead or behind schedule) and an explanation of how the project will be brought back on schedule if delays have occurred.
 2. The progress made on critical activities indicated on the CPM schedule.
 3. Explanations for any lack of WORK on critical path activities planned for the last month.
 4. Explanations for any schedule changes, including changes to the logic and to activity durations.
 5. A list of the critical activities scheduled to be performed in the next 2 months.
 6. The status of major material and equipment procurement.
 7. The value of materials and equipment properly stored at the Site but not yet incorporated into the WORK.
 8. Any delays encountered during the reporting period.
 9. An assessment of inclement weather delays and impacts to the progress of the WORK.
- E. The CONTRACTOR may include any other information pertinent to the status of the WORK. The CONTRACTOR shall include additional status information requested by the ENGINEER.

1.10 INCLEMENT WEATHER PROVISIONS OF THE SCHEDULE

- A. The CONTRACTOR's schedule shall include at least the number of Days of delay due to unusually severe weather as required by the Supplementary General Conditions.

1.11 LIQUIDATED DAMAGES

- A. If any submittal required by this Section is determined by the ENGINEER to be incomplete or is submitted later than required, the OWNER will suffer financial loss, and accordingly, the CONTRACTOR shall pay liquidated damages in accordance the CONTRACTOR's agreement with the OWNER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 33 00 - CONTRACTOR SUBMITTALS

PART 1 -- GENERAL

1.1 SUMMARY

- A. Wherever submittals are required in the Contract Documents, submit them to the OWNER or OWNER's Resident Representative as directed.
- B. Within seven (7) Days after the date of commencement as stated in the Notice to Proceed, the CONTRACTOR shall submit the following items for review:
 - 1. A preliminary schedule of Shop Drawings, Samples, and proposed Substitutes ("Or-Equal") submittals listed in the Bid. The schedule of submittals shall be based on CONTRACTOR's priority, planned construction sequence and schedule, long lead items, and size of submittal package. Allow time for resubmittals.
 - 2. A list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit and the expected date of submittal for the permit and required date for receipt of the permit.

1.2 PRECONSTRUCTION CONFERENCE SUBMITTALS

- A. At the preconstruction conference of Section 01 11 00 - Summary of Work, the submit the following items to the OWNER for review:
 - 1. A revised schedule of Shop Drawings, Samples, and proposed Substitute ("Or-Equal") submittals listed in the Bid.
 - 2. A list of permits and licenses the CONTRACTOR shall obtain, indicating the agency required to grant the permit, the expected date of submittal for the permit, and required date for receipt of the permit.
 - 3. A preliminary schedule of values in accordance with Section 01 29 00 - Schedule of Values.
 - 4. A 60-Day plan of operation in accordance with Section 01 32 15 - CPM Construction Schedule.

1.3 SHOP DRAWINGS

- A. All shop drawing submittals along with the shop drawing transmittal form, shall be made electronically in ".pdf" format and distributed by email from the CONTRACTOR to the OWNER's Resident Project Representative (RPR). The OWNER'S RPR shall be responsible to distribute each shop drawing to all reviewers and to receive and compile all review comments generated.
- B. Wherever called for in the Contract Documents or where required by the ENGINEER, the CONTRACTOR shall furnish a clear (non-scanned) electronic version, of each Shop Drawing submittal. Shop Drawings may include detail design calculations, shop-prepared drawings, fabrication and installation drawings, erection drawings, lists, graphs,

catalog sheets, data sheets, and similar items. Whenever the CONTRACTOR is required to submit design calculations as part of a submittal, such calculations shall bear the signature and seal of an engineer registered in the appropriate branch and in the state wherein the project is located, unless otherwise indicated.

- C. Shop Drawing submittals shall be accompanied by the OWNER's standard submittal transmittal form, an electronic copy of which is available from the OWNER. A submittal without the form or where applicable items on the form are not completed will be returned for resubmittal.

D. Organization

- 1. A single submittal transmittal form shall be used for each technical specification section or item or class of material or equipment for which a submittal is required. A single submittal covering multiple sections will not be acceptable, unless the primary specification references other sections for components.
- 2. On the transmittal form, index the components of the submittal and insert tabs in the submittal to match the components. Relate the submittal components to specification paragraph and subparagraph, Drawing number, detail number, schedule title, room number, or building name, as applicable.
- 3. Unless indicated otherwise, terminology and equipment names and numbers used in submittals shall match those used in the Contract Documents.

E. Format

- 1. Minimum sheet size shall be 8-1/2 inches by 11-inches. Maximum sheet size shall be 11-inches by 17-inches. Every page in a submittal shall be numbered in sequence. All sheets shall be submitted on one (1) pdf file and arranged.
- 2. Where product data from a manufacturer is submitted, clearly mark which model is proposed, with complete pertinent data capacities, dimensions, clearances, diagrams, controls, connections, anchorage, and supports. Sufficient level of detail shall be presented for assessment of compliance with the Contract Documents.
- 3. Each submittal shall be assigned a unique number. Submittals shall be numbered sequentially, and the submittal numbers shall be clearly noted on the transmittal. Original submittals shall be assigned a numeric submittal number followed by a decimal point and a "1" to indicate it is an original (first) submittal. (For example, if submittal number 16.1 requires a resubmittal, that resubmittal will bear the designation "16.2". A further resubmittal would bear the designation "16.3", etc.

- F. Disorganized submittals that do not meet the requirements of the Contract Documents will be returned without review.
- G. Except as may otherwise be indicated, the ENGINEER will return email comments (in pdf format) of each submittal to the OWNER's RPR with comments noted thereon, within 14 calendar Days following receipt by the ENGINEER. The OWNER's RPR will compile all comments and return the complete submittal (in pdf format), within 21 calendar days following original receipt by the OWNER's RPR. It is considered reasonable that the

CONTRACTOR will make a complete and acceptable submittal to the OWNER's RPR by the first resubmittal on an item. The OWNER reserves the right to withhold monies due to the CONTRACTOR to cover additional costs of the ENGINEER's review beyond the first resubmittal. The ENGINEER's and OWNER RPR's combined maximum review period for each submittal or resubmittal will be 21 calendar Days. Thus, for a submittal that requires 2 resubmittals before it is complete, the maximum review period could be 63 calendar Days.

H. **Submittal Review Marking**

1. **NO EXCEPTIONS TAKEN.** If a submittal is returned to the CONTRACTOR marked "NO EXCEPTIONS TAKEN," formal revision and resubmission will not be required.
 2. **MAKE CORRECTIONS NOTED.** If a submittal is returned marked "MAKE CORRECTIONS NOTED," CONTRACTOR shall make the corrections on the submittal, but formal revision and resubmission will not be required.
 3. **REVISE-RESUBMIT.** If a submittal is returned marked "REVISE-RESUBMIT," the CONTRACTOR shall revise it and shall resubmit the required number of copies. Resubmittal of portions of multi-page or multi-drawing submittals will not be allowed. For example, if a Shop Drawing submittal consisting of 10 drawings contains one drawing noted as "REVISE - RESUBMIT," the submittal as a whole is deemed "REVISE - RESUBMIT," and all 10 drawings are required to be resubmitted.
 4. **REJECTED-RESUBMIT.** If a submittal is returned marked "REJECTED-RESUBMIT," it shall mean either that the proposed material or product does not satisfy the specification, the submittal is so incomplete that it cannot be reviewed, or is a substitution request not submitted in accordance with Section 01 60 00 - Products, Materials, Equipment, and Substitutions. In the first 2 cases, the CONTRACTOR shall prepare a new submittal and shall resubmit. In the latter case, the CONTRACTOR shall submit the substitution request according to Section 01 60 00.
- I. Resubmittal of rejected portions of a previous submittal will not be allowed. Every change from a submittal to a resubmittal or from a resubmittal to a subsequent resubmittal shall be identified and flagged on the resubmittal.
- J. Fabrication of an item may commence only after the ENGINEER has reviewed the pertinent submittals and returned copies to the CONTRACTOR marked either "NO EXCEPTIONS TAKEN" or "MAKE CORRECTIONS NOTED." Corrections indicated on submittals shall be considered as changes necessary to meet the requirements of the Contract Documents and shall not be taken as changes to the contract requirements.
- K. Submittals shall be carefully reviewed by an authorized representative of the CONTRACTOR prior to submission to the ENGINEER. Each submittal shall be dated and signed by the CONTRACTOR as being correct and in strict conformance with the Contract Documents. In the case of Shop Drawings, each sheet shall be so dated and signed. Any deviations from the Contract Documents shall be noted on the transmittal sheet. The ENGINEER will only review submittals that have been so verified by the CONTRACTOR. Non-verified submittals will be returned to the CONTRACTOR without

action taken by the ENGINEER, and any delays caused thereby shall be the total responsibility of the CONTRACTOR.

- L. Corrections or comments made on the CONTRACTOR's Shop Drawings during review do not relieve the CONTRACTOR from compliance with Contract Drawings and Specifications. Review is for conformance to the design concept and general compliance with the Contract Documents only. The CONTRACTOR is responsible for confirming and correlating quantities and dimensions, fabrication processes and techniques, coordinating WORK with the trades, and satisfactory and safe performance of the WORK.

1.4 SAMPLES

- A. The CONTRACTOR shall submit the number of samples indicated by the Specifications. If the number is not indicated, submit not less than three (3) samples. Where the amount of each sample is not indicated, submit such amount as necessary for proper examination and testing by the methods indicated.
- B. Samples shall be individually and indelibly labeled or tagged, indicating the salient physical characteristics and manufacturer's name. Upon acceptance by the ENGINEER, one set of the samples will be stamped and dated by the ENGINEER and returned to the CONTRACTOR, one set of samples will be retained by the OWNER, and one set shall remain at the Site in the OWNER RPR's field office until completion of the WORK.
- C. Unless indicated otherwise, the OWNER will select colors and textures from the manufacturer's standard colors and standard materials, products, or equipment lines. If certain samples represent non-standard colors, materials, products, or equipment lines that will require an increase in Contract Times or Price, the CONTRACTOR shall clearly state so on the transmittal page of the submittal.
- D. The CONTRACTOR shall schedule color and texture sample submittals such that:
 - 1. Sample submittals for color and texture selection are complete so the OWNER or ENGINEER's Architect has 21 Days to assemble color panels and select color and texture dependent products and materials without delay to the construction schedule, and
 - 2. After the OWNER's or ENGINEER's Architect selects colors and textures, the CONTRACTOR has sufficient time to provide the products or materials without delay to the construction schedule. The Contract Times will not be extended for the CONTRACTOR's failure to allow enough review and approval or selection time, failure to submit complete samples requiring color or texture selection, or failure to submit complete or approvable samples.

1.5 TECHNICAL MANUAL

- A. The CONTRACTOR shall submit technical operation and maintenance information for each item of mechanical, electrical, and instrumentation equipment in an organized manner in the Technical Manual. It shall be written so that it can be used and understood by the OWNER's operation and maintenance staff.

- B. **Organization.** The Technical Manual shall be subdivided first by specification section number; second, by equipment item; and last, by "Category." The following "Categories" shall be addressed (as applicable):

1. **Category 1 - Equipment Summary**

- a. Summary: A table shall indicate the equipment name, equipment number, and process area in which the equipment is installed.
- b. Form: The ENGINEER will supply an Equipment Summary Form for each item of mechanical, electrical, and instrumentation equipment in the WORK. The CONTRACTOR shall fill in the relevant information on the form and include it in Part 1.

2. **Category 2 - Operational Procedures**

- a. Operational and Maintenance procedures shall be written in Microsoft TM Word document format for the startup, operation, maintenance, emergency situations and shutdown for all facility systems. The procedures shall be written in a step by step method for proper operation or maintenance of each individual system. For example, the startup procedure for a water supply to raceways system shall include operation of valves, gates, meters, HMI procedures, etc. to bring the system online and functioning properly.
- b. Manufacturer-recommended procedures on the following shall be included in Part 2:
 - 1) Installation
 - 2) Adjustment
 - 3) Startup
 - 4) Location of controls, special tools, equipment required, or related instrumentation needed for operation
 - 5) Operation procedures
 - 6) Load changes
 - 7) Calibration
 - 8) Shutdown
 - 9) Troubleshooting
 - 10) Disassembly
 - 11) Reassembly
 - 12) Realignment

- 13) Testing to determine performance efficiency
- 14) Tabulation of proper settings for pressure relief valves, low and high pressure switches, and other protection devices
- 15) List of all electrical relay settings including alarm and contact settings

3. Category 3 - Preventive Maintenance Procedures

- a. Procedures: Preventive maintenance procedures shall include manufacturer-recommended procedures to be performed on a periodic basis, both by removing and replacing the equipment or component, and by maintaining the equipment in place.
- b. Schedules: Recommended frequency of preventive maintenance procedures shall be included. Lubrication schedules, including lubricant SAE grade, type, and temperature ranges, shall be covered.

4. Category 4 - Wiring and Loop Diagrams

- a. Diagrams: This category includes complete internal and connection wiring diagrams for electrical and instrumentation equipment items.

5. Category 5 - Shop Drawings

- a. Drawings: This category includes approved shop or fabrication drawings with ENGINEER comments and corrections incorporated, complete with dimensions.

6. Category 6 - Parts List

- a. Parts List: A complete parts list shall be furnished, including a generic description and manufacturer's identification number for each part. Addresses and telephone numbers of the nearest supplier and parts warehouse shall be included.
- b. Drawings: Cross-sectional or exploded view drawings shall accompany the parts list. Part numbers shall appear on the drawings with arrows to the corresponding part.

7. Category 7 - Safety

- a. Procedures: This category describes the safety precautions to be taken when operating and maintaining the equipment or working near it.

8. Category 8 – Documentation & Warrantees

- a. Equipment warranties, affidavits, certifications, calibrations, laboratory test results, etc. required by the Technical Specifications shall be placed in this category.

C. Format

1. Each Technical Manual shall be bound in standard size 3 ring hardcover binders labeled on the spine and cover with project name, OWNER's project number, specification section number, equipment name, and equipment identification number
2. Each Binder shall contain its own detailed table of contents at the front, plus a summary level table of contents information for the other binders in a multi-binder set.
3. Documents in binders shall be 3-hole punched, no text shall be punched out, and pages larger than 8-1/2 inches by 11-inches shall be folded to 8-1/2 inches by 11-inches. Binder ring size shall not exceed 2.5-inches in diameter.
4. Each final set of Technical Manuals shall include a CD with electronic files:
 - a. Project specific files created in Microsoft Office, AutoCAD version 2018, Adobe Acrobat portable document format, or other software required by the specifications.
 - b. Manufacturer literature in Adobe Acrobat portable document format (pdf).

D. Technical Manual Review Process

1. The CONTRACTOR shall furnish three (3) draft Technical Manuals for each Specification Section that requires a Manual. The OWNER's RPR will retain one (1) copy, will forward one (1) copy to the OWNER, and will return one (1) copy to the CONTRACTOR with review comments.
2. The CONTRACTOR shall incorporate all comments into the draft and shall submit five (5) identical hard copies of the final Manual, bound in 3-ring binders, for acceptance.

E. Schedule

1. Except where indicated otherwise, Technical Manuals shall be submitted in final form to the OWNER's RPR not later than the 80 percent of construction completion date. Discrepancies found by the OWNER or ENGINEER shall be corrected within 30 Days from the date of written notification by the OWNER's RPR.

1.6 SPARE PARTS LIST

- A. The CONTRACTOR shall furnish to the OWNER spare parts information for mechanical, electrical, and instrumentation equipment. The spare parts list shall include those spare parts that each manufacturer recommends be maintained by the OWNER in inventory.
 1. **Sources and Pricing:** The spare parts list shall include a current list price of each spare part. Each manufacturer or supplier shall indicate the name, address, and telephone number of its nearest outlet of spare parts to assist the OWNER in ordering.
 2. **Format:** The CONTRACTOR shall cross-reference spare parts lists to the equipment numbers designated in the Contract Documents. The spare parts lists

shall be bound in standard size, 3 ring, loose-leaf, vinyl plastic hard cover binders suitable for bookshelf storage. Binder ring size shall not exceed 2.5 inches.

1.7 RECORD DRAWINGS

- A. The CONTRACTOR shall maintain one set of Drawings at the Site for the preparation of record drawings. On these, it shall mark every project condition, location, configuration, and any other change or deviation which may differ from the Contract Drawings at the time of award, including buried or concealed construction and utility features that are revealed during the course of construction. Special attention shall be given to recording the horizontal and vertical location of buried utilities that differ from the locations indicated, or that were not indicated on the Contract Drawings.
- B. The record drawings shall be supplemented by any detailed sketches as necessary or as CONTRACTOR is directed, to fully indicate the WORK as actually constructed. These record drawings are the CONTRACTOR's representation of as-built conditions, shall include revisions made by addenda and change orders, and shall be maintained up to date during the progress of the WORK. Red ink shall be used for alterations and notes. Notes shall identify relevant Change Orders by number and date.
- C. 11-inch x 17-inch size paper copies of the record drawings shall be submitted to the OWNER's RRP at 120-day intervals, starting after the date of the Notice to Proceed, and also at completion of WORK. Failure to submit complete record drawings on or before these dates will enact the liquidated damages clause for interim record drawing submittals described in Division 00 Contract Specifications.
- D. In the case of those drawings that depict the detail requirement for equipment to be assembled and fabricated in the factory, the record drawings shall be updated by indicating those portions which are superseded by change order drawings or final Shop Drawings, and by including appropriate reference information describing the change orders by number and the Shop Drawings by manufacturer, drawing, and revision numbers.
- E. Disorganized or incomplete record drawings will not be accepted. The CONTRACTOR shall revise them and resubmit the drawings for review.
- F. Record drawings shall be accessible to the OWNER's RPR during the construction period.
- G. Final payment will not be acted upon until the record drawings have been completed and delivered to the OWNER's RPR. Said up-to-date record drawings shall be in the form of a set of prints with carefully plotted information overlaid on the Contract Drawings.
- H. Information submitted by the CONTRACTOR will be assumed to be correct, and the CONTRACTOR shall be responsible for the accuracy of such information

1.8 QUALITY CONTROL (QC) SUBMITTALS

- A. Quality control submittals are defined as those required by the Specifications to present documentary evidence to the OWNER and ENGINEER that the CONTRACTOR has satisfied certain requirements of the Contract Documents.

B. Unless otherwise indicated, QC submittals shall be submitted:

1. Before delivery and unloading, for the following types of submittals:

- a. Manufacturers' installation instructions
- b. Manufacturers' and Installers' experience qualifications
- c. Affidavits and manufacturers' certification of compliance with indicated product requirements
- d. Laboratory analysis results
- e. Factory test reports
- f. Ready mix concrete delivery tickets
- g. Design calculations

2. Within 30 Days of the event documented for the following types of submittals:

- a. Manufacturers' field representative certification of proper installation
- b. Field measurement
- c. Field test reports
- d. Receipt of permit
- e. Receipt of regulatory approval

C. The OWNER's RPR and ENGINEER will record the date that a QC submittal was received and review it for compliance with submittal requirements, but the review procedures above for Shop Drawings and samples will not apply.

1.9 INFORMATIONAL SUBMITTALS

A. Informational submittals, such as Requests for Information (RFI), Deviation Request (DR), Change Order Proposals (COR), etc. formalize the flow of information between the CONTRACTOR and the ENGINEER. The OWNER's standard forms will be employed for such purpose. Electronic copies of all standard Construction Management forms shall be provided by the OWNER to the CONTRACTOR.

1.10 CONSTRUCTION PHOTOGRAPHS

A. The CONTRACTOR shall be responsible to take digital construction photographs, no less than once per week, showing the progress of the WORK, including documentation of all buried utilities encountered during construction as well as installation of new buried utilities and buried WORK required by the Contract.

- B. Upon completion of the WORK and before final payment, the CONTRACTOR shall electronically submit all photographs to the OWNER on a SharePoint site or other electronic media with each photograph's file name identified by location and date it was taken.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 -- GENERAL

1.1 QUALITY CONTROL

- A. The CONTRACTOR shall provide tests and reports described in this section with any tests, reports, and other information that may be additionally required in any section of the specifications.

1.2 TESTS BY INDEPENDENT TESTING LABORATORY

A. Testing Laboratory

- 1. The OWNER will select and direct an independent construction inspector and testing laboratory (Testing Lab) to perform inspection and testing services as described in this Section. The construction inspector and testing laboratory will work solely at the direction of the OWNER's own Quality Assurance program. The CONTRACTOR shall include the cost in the price proposal to provide his own testing services program.

B. The CONTRACTOR shall:

- 1. Make available and deliver to Testing Lab, at the CONTRACTOR's expense, all materials to be tested. The CONTRACTOR shall be responsible for coordinating all testing.
- 2. Provide labor necessary to supply samples and assist in making tests.
- 3. Advise Testing Lab of the identity of material sources and instruct suppliers to allow inspections by the laboratory if so desired by the OWNER.

C. The testing lab is not authorized to:

- 1. Release, revoke, alter or enlarge on, contract requirements.
- 2. Approve or accept any portion of the work.
- 3. Perform any duties required of the CONTRACTOR, including any testing work requested by the CONTRACTOR for verification.

- D. Tests shall be conducted in accordance with the requirements of the specifications as designated or, where not specified, as requested by the OWNER. All testing will be in accordance with the latest standards of American Society for Testing and Materials.

1.3 INDEPENDENT TESTING LABORATORY SERVICES, TESTS AND RELATED CONTRACTOR RESPONSIBILITIES

- A. Testing Lab Services will be performed for, though are not limited to, the following items:

- 1. Compacted Soils

- a. The Testing Lab will secure samples of onsite fills proposed for use or being used in construction and test for proper gradation (sieve analysis) in accordance with the applicable sections of these specifications. This will also be done on CONTRACTOR provided samples from offsite borrow sources.
- b. The Testing Lab will establish optimum moisture – density relationship in accordance with ASTM D698 (Standard Proctor).
- c. The OWNER reserves the right to make or request in-situ tests of fills and backfills at any time, above those require by the CONTRACTOR, in order to determine compliance with the specifications.

2. Concrete

- a. The Testing Lab will test samples of aggregates CONTRACTOR proposes to use for compliance with specifications.
- b. The OWNER will verify compliance with the specifications for cement proposed for use by the CONTRACTOR based on data submitted by the CONTRACTOR.
- c. The Testing Lab will review the CONTRACTOR's proposed design concrete mix, as well as perform appropriate laboratory tests during construction, including compression tests of cylinders and slump test, if required, to substantiate mix designs.
- d. When requested by the OWNER, the Testing Lab will inspect and collect test materials during concrete work to substantiate compliance with specifications and mix requirements.
- e. Slump Test
 - 1) The right to perform or request a slump test by the CONTRACTOR at any time, which may be in addition to the CONTRACTOR's testing, is reserved for the OWNER.
 - 2) Test cylinders shall be prepared and supplied by the CONTRACTOR as required by SECTION 03 30 00 as follows:
 - a) Each set of test cylinders shall consist of three cylinders prepared by the Contractor.
 - b) Test cylinders shall be made and cured by the Contractor in conformity with ASTM C31. No sooner than 24 hours, but no more than 48 hours, after taking cylinders, the Contractor shall carefully transport the cylinders to the Testing Laboratory for moisture curing.
- f. The Testing Lab will perform the required number of compression tests as follows:
 - 1) Test one cylinder to failure at 7 days.

- 2) Test two (2) cylinders at 28 days in accordance with ASTM C39 and SECTION 03 30 00 of these specifications.
- g. The CONTRACTOR shall identify all test cylinders with symbols to indicate location on the job where concrete test was made. Symbols will be used to record placement locations on record drawings.
3. The Testing Lab will verify roadway Aggregate Gradation and Compaction in Accordance with applicable specifications.

1.4 CONTRACTOR'S RESPONSIBILITIES

- A. Furnish product data meeting or exceeding contract requirements in accordance with the applicable specifications.
- B. Cooperate with any of OWNER and Testing Lab personnel, in providing access to work and to manufacturer's or suppliers operations.
 1. Direct CONTRACTOR's representative, if desired, to monitor each inspection, sampling and test.
 2. The CONTRACTOR shall, within 24 hours, notify the OWNER in writing of reasons for not acknowledging field testing and sampling procedures.
- C. Provide to the Testing Lab, initial representative samples of materials to be tested, in specified quantities.
- D. Furnish copies of mill test reports.
- E. Furnish verification of compliance with contract requirements for materials and equipment.
- F. Furnish labor and facilities:
 1. To provide access to work to be tested.
 2. To obtain, handle and transport samples at site.
 3. To facilitate inspections and tests.
 4. For the Testing Lab's exclusive use for storage and pouring of concrete test samples.
- G. Notify the OWNER, Construction Inspector, and the Testing Lab sufficiently in advance of operations to allow for assignment of personnel and scheduling of tests. A minimum of two (2) days advance notice will be provided. CONTRACTOR shall notify the OWNER, Construction Inspector and the Testing Lab when work is ready for testing. The CONTRACTOR shall provide a schedule for the Testing Lab for acceptance by the Construction Inspector and OWNER. The CONTRACTOR shall pay for any testing he or any of his representatives or employees schedule as defined in these specifications.

- H. Work which is defective, or which fails to conform to the contract documents shall be corrected by the CONTRACTOR at the CONTRACTOR's sole expense. Corrective work shall not be cause for delay in the project schedule or the work of another CONTRACTOR.
- I. Pay all costs of retesting when test results indicate non-compliance with contract requirements.
- J. Restore all surfaces and areas disturbed by testing operations to conditions existing before testing.

1.5 QUALIFICATIONS FOR WELDING WORK

- A. Welders employed in executing work under this project shall possess qualification papers given by an independent testing laboratory under AWS Code, Standard Qualifications Procedure.
- B. The qualification papers shall be dated no earlier than six months prior to the start of the project. Welders not engaged in welding for a period of three or more months within the 6 months preceding construction must be re-qualified.

- END OF SECTION -

SECTION 01 42 10 - REFERENCE STANDARDS

PART 1 -- GENERAL

1.1 GENERAL

- A. **Titles of Sections and Paragraphs:** Titles and subtitles accompanying specification sections and paragraphs are for convenience and reference only and do not form a part of the Specifications.
- B. **Applicable Publications:** Whenever in these Specifications references are made to published specifications, codes, standards, or other requirements, it shall be understood that wherever no date is indicated, only the latest specifications, standards, or requirements of the respective issuing agencies which have been published as of the date that the Contract is advertised for Bids shall apply; except to the extent that said standards or requirements may be in conflict with applicable laws, ordinances, or governing codes. No requirements set forth in the Specifications or shown on the Drawings will be waived because of any provision of or omission from said standards or requirements.
- C. **Specialists, Assignments:** In certain instances, specification text requires (or implies) that specific WORK is to be assigned to specialists or expert entities who must be engaged to perform that WORK. Such assignments shall be recognized as special requirements over which the CONTRACTOR has no choice or option. These requirements shall not be interpreted so as to conflict with the enforcement of building codes and similar regulations governing the WORK; also, they are not intended to interfere with local union jurisdiction settlements and similar conventions. Such assignments are intended to establish which party or entity involved in a specific unit of WORK is recognized as "expert" for the indicated construction processes or operations. Nevertheless, the final responsibility for fulfillment of the entire set of Contract requirements remains with the CONTRACTOR.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

- A. The CONTRACTOR shall construct the WORK in accordance with the Contract Documents and the referenced portions of those referenced codes, standards, and specifications.
- B. References to "Building Code", "International Building Code", or "California Building Code" shall mean California Building Code as amended by the local jurisdiction. Similarly, references to "Mechanical Code" or "Uniform Mechanical Code," "Plumbing Code" or "Uniform Plumbing Code," "Fire Code" or "Uniform Fire Code," shall mean Uniform Mechanical Code, Uniform Plumbing Code and Uniform Fire Code of the International Association of Plumbing and Mechanical Officials (IAPMO) as amended by the local jurisdiction. "Electric Code" or "National Electric Code (NEC)" shall mean the National Electric Code of the National Fire Protection Association (NFPA). The latest edition of the codes as approved by the Municipal Code and used by the local agency as of the date that the WORK is advertised for Bids shall apply to the WORK herein, including all addenda, modifications, amendments, or other lawful changes thereto.

- C. In case of conflict between codes, reference standards, drawings, and the other Contract Documents, the most stringent requirements shall govern. All conflicts shall be brought to the attention of the ENGINEER for clarification and direction prior to ordering or providing any materials or furnishing labor. The CONTRACTOR shall bid for the most stringent requirements.
- D. References to "OSHA Regulations for Construction" shall mean **Title 29, Part 1926, Construction Safety and Health Regulations**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- E. References to "OSHA Standards" shall mean **Title 29, Part 1910, Occupational Safety and Health Standards**, Code of Federal Regulations (OSHA), including all changes and amendments thereto.
- F. **Applicable Safety Standards:** References to "Cal-OSHA" shall mean State of California, Department of Industrial Relations, Construction Safety Orders, as amended to date, and all changes and amendments thereto.

1.3 REGULATIONS RELATED TO HAZARDOUS MATERIALS

- A. The CONTRACTOR shall be responsible that all WORK included in the Contract Documents, regardless if indicated or not, shall comply with all EPA, OSHA, RCRA, NFPA, and any other federal, state, and local regulations governing the storage and conveyance of hazardous materials, including petroleum products.
- B. Where no specific regulations exist and the OWNER has not waived the requirement in writing, chemical, hazardous, and petroleum product piping and storage in underground locations shall be double containment piping and tanks or be installed in separate concrete trenches and vaults with an approved lining that cannot be penetrated by the chemicals.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 42 13 - ABBREVIATIONS OF INSTITUTIONS

PART 1 -- GENERAL

1.1 GENERAL

- A. Wherever in these Specifications references are made to the standards, specifications, or other published data of the various international, national, regional, or local organizations, such organizations may be referred to by their acronym or abbreviation only. As a guide to the user of the Specifications, the following acronyms or abbreviations which may appear shall have the meanings indicated herein.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ABMA	American Bearing Manufacturer's Association – ABMA
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADM	Aluminum Design Manual
AF&PA	American Forest and Paper Association
AGA	American Gas Association
AGMA	American Gear Manufacturers Association
AHA	American Hardboard Association
AHAM	Association of Home Appliance Manufacturers
AI	The Asphalt Institute
AIA	American Institute of Architects
AIHA	American Industrial Hygiene Association
AIIM	Association for Information and Image Management
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMA	Acoustical Material Association
AMCA	Air Movement and Control Association International, Inc
ANS	American Nuclear Society
ANSI	American National Standards Institute, Inc.
APA	The Engineered Wood Association
API	American Petroleum Institute
APWA	American Public Works Association
ARI	Air-Conditioning and Refrigeration Institute
ASA	Acoustical Society of America
ASAE	American Society of Agricultural Engineers
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASNT	American Society of Nondestructive Testing
ASQ	American Society for Quality
ASSE	American Society of Sanitary Engineers
ASTM	American Society for Testing and Materials

AWCI	American Wire Cloth Institute
AWI	Architectural Woodwork Institute
AWPA	American Wood Preservers Association
AWPI	American Wood Preservers Institute
AWS	American Welding Society
AWWA	American Water Works Association
BBC	Basic Building Code, Building Officials and Code Administrators International
BHMA	Builders Hardware Manufacturer's Association
CABO	Council of American Building Officials
CBC	California Building Code
CCOR	California Code of Regulations
CDA	Copper Development Association
CEMA	Conveyors Equipment Manufacturer's Association
CGA	Compressed Gas Association
CLFMI	Chain Link Fence Manufacturer's Institute
CLPCA	California Lathing and Plastering Contractors Association
CMAA	A division/section of the Material Handling Industry of America
CRSI	Concrete Reinforcing Steel Institute
DCDMA	Diamond Core Drilling Manufacturer's Association
DHI	Door and Hardware Institute
DIPRA	Ductile Iron Pipe Research Association
EI	Energy Institute
EIA	Electronic Industries Alliance
EPA	Environmental Protection Agency
ETL	Electrical Test Laboratories
FCC	Federal Communications Commission
FCI	Fluid Controls Institute
FEMA	Federal Emergency Management Association
FHWA	Federal Highway Administration
FM	Factory Mutual System
FPL	Forest Products Laboratory
HI	Hydronics Institute, Hydraulic Institute
HSWA	Federal Hazardous and Solid Waste Amendments
IAPMO	International Association of Plumbing and Mechanical Officials
ICBO	International Conference of Building Officials
IBC	International Building Code
ICC	International Code Council
ICEA	Insulated Cable Engineers Association
ICCEC	Electrical Code
ICC-ES	International Code Council Evaluation Service
IEEE	Institute of Electrical and Electronics Engineers
IESNA	Illuminating Engineering Society of North America
IFC	International Fire Code
IFGC	International Fuel Gas Code
IMC	International Mechanical Code
IME	Institute of Makers of Explosives
IPC	International Plumbing Code, Association Connecting Electronic Industries
IRC	International Residential Code
ISA	Instrument Society of America
ISDI	Insulated Steel Door Institute

ISEA	Industrial Safety Equipment Association
ISO	International Organization for Standardization
ITE	Institute of Traffic Engineers
ITU-T	Telecommunications Standardization Sector of the International Telecommunications Union
LPI	Lightning Protection Institute
LRQA	Lloyd's Register Quality Assurance
MBMA	Metal Building Manufacturer's Association
MIL	Military Standards (DoD)
MPTA	Mechanical Power Transmission Association
MSS	Manufacturers Standardization Society
NAAMM	National Association of Architectural Metal Manufacturer's
NACE	National Association of Corrosion Engineers
DASMA	Door and Access Systems Manufacturers Association International
NAPF	National Association of Pipe Fabricators
NBBPVI	National Board of Boiler and Pressure Vessel Inspectors
NCCLS	National Committee for Clinical Laboratory Standards
NCMA	National Concrete Masonry Association
NEC	National Electrical Code
NEMA	National Electrical Manufacturer's Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association or National Fluid Power Association
NISO	National Information Standards Organization
NIST	National Institute of Standards and Technology
NLGI	National Lubricating Grease Institute
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRCA	National Roofing Contractors Association
NSF	National Sanitation Foundation
NWWDA	National Wood Window and Door Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Precast/Prestressed Concrete Institute
PPI	Plastic Pipe Institute
RCRA	Resource Conservation and Recovery Act
RIS	Redwood Inspection Service, a division of the California Redwood Association, CRA
RMA	Rubber Manufacturers Association
RVIA	Recreational Vehicle Industry Association
RWMA	Resistance Welder Manufacturer's Association
RWQBC	Regional Water Quality Control Board
SAE	Society of Automotive Engineers
SDI	Steel Door Institute, Steel Deck Institute
SMA	Screen Manufacturers Association
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SPFA	Steel Plate Fabricator's Association
SPIB	Southern Pine Inspection Bureau
SSBC	Southern Standard Building Code, Southern Building Code Congress
SSPC	Society for Protective Coating
SSPWC	Standard Specifications for Public Works Construction

STLE	Society of Tribologists and Lubricating Engineers
TAPPI	Technical Association of the Worldwide Pulp, Paper, and Converting Industry
TFI	The Fertilizer Institute
TIA	Telecommunications Industries Association
TPI	Truss Plate Institute
UBC	Uniform Building Code
UL	Underwriters Laboratories, Inc.
USACE	United States Army Corps of Engineers
WCLIB	West Coast Lumber Inspection Bureau
WDMA	National Window and Door Manufacturers Association
WEF	Water Environment Federation
WI	Woodwork Institute
WRI	Wire Reinforcement Institute, Inc.
WWPA	Western Wood Products Association

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 57 20 - TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 -- GENERAL

1.1 SUMMARY

- A. WORK includes furnishing all labor, materials and equipment required for the installation and maintenance of temporary environmental controls, including erosion and sediment controls.

1.2 SUBMITTALS

- A. Storm Water Pollution Prevention Plan (SWPPP): Submit a SWPPP indicating storm water pollution prevention measures, erosion and sediment control measures and products, as well as installation, maintenance, repair, and removal procedures.
- B. Notice of Intent (NOI).

1.3 DUST ABATEMENT

- A. The CONTRACTOR shall prevent its operation from producing dust in amounts damaging to property, cultivated vegetation, or domestic animals, or causing a nuisance to persons living in or occupying buildings in the vicinity of the Site. The CONTRACTOR shall be responsible for any damage resulting from dust originating from its operations. Dust abatement measures shall be continued until the CONTRACTOR is relieved of further responsibility by the ENGINEER.
- B. **Storage Piles:** Enclose, cover, water (as needed), or apply non-toxic soil binders according to manufacturer's specifications on material piles (i.e. gravel, sand, dirt) with a silt content of 5 percent or greater.
- C. **Active Areas of Site:** Water active construction areas and unpaved roads as needed and as requested by ENGINEER.
- D. **Inactive Areas of Site:** Apply non-toxic soil stabilizers according to manufacturer's specifications to inactive construction areas, or water as needed to maintain adequate dust control.
- E. **Vehicle Loads:** Cover or maintain at least 2-feet of freeboard vertical distance between the top of the load and the top of the trailer sides on trucks hauling dirt, sand, soil, or other loose materials off of the Site.
- F. **Roads:** When there is visible track-out onto a paved public road, install approved Best Management Practices where the vehicles exit and enter onto the paved roads. Sweep the paved street at the end of each shift with a water spray pick-up broom-type street sweeper as necessary or as directed.
- G. **Vehicle Speeds:** If watering of unpaved roads is not sufficient to control dust, reduce vehicle speeds as necessary to control dust.

1.4 STORMWATER POLLUTION PREVENTION

- A. CONTRACTOR shall minimize stormwater pollution from the Site in accordance with this Section and with the Storm Water Pollution Prevention Plan.

1.5 RUBBISH CONTROL

- A. During the progress of the WORK, the CONTRACTOR shall keep the Site and other areas for which it is responsible in a neat and clean condition and free from any accumulation of rubbish. The CONTRACTOR shall dispose of rubbish and waste materials of any nature and shall establish regular intervals of collection and disposal of such materials and waste. The CONTRACTOR shall also keep its haul roads free from dirt, rubbish, and unnecessary obstructions resulting from its operations. Disposal of rubbish and surplus materials shall be off the Site in accordance with local codes and ordinances governing locations and methods of disposal and in conformance with applicable safety laws and the particular requirements of Part 1926 of the OSHA Safety and Health Standards for Construction.

1.6 SANITATION

- A. **Toilet Facilities:** Fixed or portable chemical toilets shall be provided wherever needed for the use of employees. Toilets shall conform to the requirements of Part 1926 of the OSHA Safety and Health Regulations for Construction.
- B. **Sanitary and Other Organic Wastes:** The CONTRACTOR shall establish a regular daily collection of sanitary and organic wastes. Wastes and refuse from sanitary facilities provided by the CONTRACTOR or organic material wastes from any other source related to the CONTRACTOR's operations shall be disposed of away from the Site in a manner satisfactory to the ENGINEER and in accordance with Laws and Regulations pertaining thereto.

1.7 CHEMICALS

- A. Chemicals used on the WORK or furnished for facility operation, whether defoliant, soil sterilant, herbicide, pesticide, disinfectant, polymer, reactant, or of other classification, shall show approval of either the U.S. Environmental Protection Agency or the U.S. Department of Agriculture. Use of such chemicals and disposal of residues shall be in strict accordance with the printed instructions of the manufacturer. In addition, see the requirements set forth in paragraph 6.11 of the General Conditions.

1.8 CULTURAL RESOURCES

- A. The CONTRACTOR's attention is directed to the National Historic Preservation Act of 1966 (16 U.S.C. 470) and 36 CFR 800 which provides for the preservation of potential historical architectural, archaeological, or cultural resources (hereinafter called "cultural resources").
- B. In the event potential cultural resources are discovered during subsurface excavations at the Site, the following procedures shall be instituted:

1. The OWNER will issue a temporary Notice to Suspend Work directing the CONTRACTOR to cease construction operations at the location of such potential cultural resources find.
 2. The suspension Notice will contain the following:
 - a. A clear description of the WORK to be suspended
 - b. Instructions regarding issuance of further orders by the CONTRACTOR for material services
 - c. Guidance as to the action to be taken on subcontracts
 - d. Suggestions to the CONTRACTOR to minimize incurred costs
 - e. Estimated duration of the temporary suspension.
 3. Such suspension shall be effective until such time as a qualified archeologist can assess the value of the potential cultural resources and make recommendations to the State Water Resources Control Board Cultural Resources Officer.
 4. The OWNER will implement appropriate actions as directed by the State Board Cultural Resources Officer or Project Manager. The CONTRACTOR shall cease WORK in the area of a discovery until appropriate actions have been determined in accordance with this paragraph.
 5. If human remains are discovered, WORK in the immediate vicinity of the find shall stop. The Local Law Enforcement Agency shall be notified (Section 7050.5 of the California Health and Safety Code).
- C. If the archeologist determines that the potential find is a bonafide cultural resource, at the direction of the State Water Resources Control Board Cultural Resources Officer, the OWNER will extend the duration of the suspension.
- D. Changes to the Contract Price and Contract Times for suspension due to discovery of a potential cultural resource will be made in the following manner:
1. Contract Times
 - a. If the WORK temporarily suspended is on the "critical path", the total number of Days for which the suspension is in effect will be added to the Contract Times.
 - b. If a portion of WORK at the time of such suspension is not on the "critical path", but subsequently becomes WORK on the critical path, the Contract Times will be computed from the date such WORK is classified as on the critical path.
 2. Contract Price
 - a. If, as a result of a cultural resources suspension, the CONTRACTOR sustains a loss that could not have been avoided by judicious handling of forces and equipment or redirection of forces or equipment to perform other WORK on the

contract, there will be paid an amount based on time and materials for the loss in accordance with the following:

- 1) Idle Time of Equipment: Compensation for equipment idle time will be determined in accordance with the General Conditions for equipment time and equipment rental time.
 - 2) Idle Time of Labor: Compensation for idle time of workers will be determined in accordance with the General Conditions for labor.
- b. Costs of labor will be compensated only to the extent such cost was in fact caused by the suspension.
 - c. Compensation for loss due to idle time of either equipment or labor will not include markup for profit.
 - d. The hours for which compensation will be paid will be the actual normal working time during which such suspension lasts but will in no case exceed eight hours in any single Day.
 - e. The days for which compensation will be paid exclude Saturdays, Sundays, and legal holidays during the suspension.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 60 00 - PRODUCTS, MATERIALS, EQUIPMENT AND SUBSTITUTIONS

PART 1 -- GENERAL

1.1 DEFINITIONS

- A. The word "Products," as used in the Contract Documents is defined to include purchased items for incorporation into the WORK, regardless of whether specifically purchased for the project or taken from CONTRACTOR's stock of previously purchased products. The word "Materials," is defined as products which must be substantially cut, shaped, worked, mixed, finished, refined, or otherwise fabricated, processed, installed, or applied to form WORK. The word "Equipment" is defined as products with operational parts, regardless of whether motorized or manually operated, and particularly including products with service connections (wiring, piping, and other like items). Definitions in this paragraph are not intended to negate the meaning of other terms used in the Contract Documents, including "specialties," "systems," "structure," "finishes," "accessories," "furnishings," special construction," and similar terms, which are self-explanatory and have recognized meanings in the construction industry.
- B. Neither "Products" nor "Materials" nor "Equipment" includes machinery and equipment used for preparation, fabrication, conveying, and erection of the WORK.

1.2 QUALITY CONTROL

- A. **Source Limitations:** To the greatest extent possible for each unit of WORK, the CONTRACTOR shall provide products, materials, and equipment of a singular generic kind from a single source.
- B. **Compatibility of Options:** Where more than one choice is available as options for CONTRACTOR's selection of a product, material, or equipment, the CONTRACTOR shall select an option which is compatible with other products, materials, or equipment. Compatibility is a basic general requirement of product, material and equipment selections.

1.3 PRODUCT DELIVERY AND STORAGE

- A. The CONTRACTOR shall deliver and store the WORK in accordance with manufacturer's written recommendations and by methods and means which will prevent damage, deterioration, and loss including theft. Delivery schedules shall be controlled to minimize long-term storage of products at the Site and overcrowding of construction spaces. In particular, the CONTRACTOR shall ensure coordination to ensure minimum holding or storage times for flammable, hazardous, easily damaged, or sensitive materials to deterioration, theft, and other sources of loss.

1.4 TRANSPORTATION AND HANDLING

- A. Products shall be transported by methods to avoid damage and shall be delivered in undamaged condition in manufacturer's unopened containers and packaging.

- B. The CONTRACTOR shall provide equipment and personnel to handle products, materials, and equipment including those furnished by OWNER, by methods to prevent soiling and damage.
- C. The CONTRACTOR shall provide additional protection during handling to prevent marring and otherwise damaging products, packaging, and surrounding surfaces.

1.5 STORAGE AND PROTECTION

- A. Products shall be stored in accordance with manufacturer's written instructions and with seals and labels intact and legible. Sensitive products shall be stored in weather-tight climate-controlled enclosures and temperature and humidity ranges shall be maintained within tolerances required by manufacturer's recommendations.
- B. For exterior storage of fabricated products, products shall be placed on sloped supports above ground. Products subject to deterioration shall be covered with impervious sheet covering and ventilation shall be provided to avoid condensation.
- C. Loose granular materials shall be stored on solid flat surfaces in a well-drained area and shall be prevented from mixing with foreign matter.
- D. Storage shall be arranged to provide access for inspection. The CONTRACTOR shall periodically inspect to assure products are undamaged and are maintained under required conditions.
- E. Storage shall be arranged in a manner to provide access for maintenance of stored items and for inspection.

1.6 MAINTENANCE OF PRODUCTS IN STORAGE

- A. Stored products shall be periodically inspected on a scheduled basis. The CONTRACTOR shall maintain a log of inspections and shall make the log available on request.
- B. The CONTRACTOR shall comply with manufacturer's product storage requirements and recommendations.
- C. The CONTRACTOR shall maintain manufacturer-required environmental conditions continuously.
- D. The CONTRACTOR shall ensure that surfaces of products exposed to the elements are not adversely affected and that weathering of finishes does not occur.
- E. For mechanical and electrical equipment, the CONTRACTOR shall provide a copy of the manufacturer's service instructions with each item and the exterior of the package shall contain notice that instructions are included.
- F. Products shall be serviced on a regularly scheduled basis, and a log of services shall be maintained and submitted as a record document prior to final acceptance by the OWNER in accordance with the Contract Documents.

1.7 PROPOSED SUBSTITUTIONS OR "OR-EQUAL" ITEM

- A. Whenever materials or equipment are indicated in the Contract Documents by using the name of a proprietary item or the name of a particular manufacturer, the naming of the item is intended to establish the type, function, and quality required. If the name is followed by the words "or equal" indicating that a substitution is permitted, materials or equipment of other manufacturers may be accepted if sufficient information is submitted by the CONTRACTOR to allow the ENGINEER to determine that the material or equipment proposed is equivalent or equal to that named, subject to the following requirements:
1. The burden of proof as to the type, function, and quality of any such substitution product, material or equipment shall be upon the CONTRACTOR.
 2. The ENGINEER will be the sole judge as to the type, function, and quality of any such substitution and the ENGINEER's decision shall be final.
 3. The ENGINEER may require the CONTRACTOR to furnish additional data about the proposed substitution.
 4. The OWNER may require the CONTRACTOR to furnish a special performance guarantee or other surety with respect to any substitution.
 5. Acceptance by the ENGINEER of a substitution item proposed by the CONTRACTOR shall not relieve the CONTRACTOR of the responsibility for full compliance with the Contract Documents and for adequacy of the substitution.
 6. The CONTRACTOR shall pay all costs of implementing accepted substitutions, including redesign and changes to WORK necessary to accommodate the substitution.
- B. The procedure for review by the ENGINEER will include the following:
1. If the CONTRACTOR wishes to provide a substitution item, the CONTRACTOR shall make written application to the ENGINEER on the "Substitution Request Form."
 2. Unless otherwise provided by law or authorized in writing by the ENGINEER, the "Substitution Request Form(s)" shall be submitted within the 35 Day period after award of the Contract.
 3. Wherever a proposed substitution item has not been submitted within said 35 Day period, or wherever the submission of a proposed substitution material or equipment has been judged to be unacceptable by the ENGINEER, the CONTRACTOR shall provide the material or equipment indicated in the Contract Documents.
 4. The CONTRACTOR shall certify by signing the form that the list of paragraphs on the form are correct for the proposed substitution.
 5. The ENGINEER will evaluate each proposed substitution within a reasonable period of time.

6. As applicable, no shop drawing submittals shall be made for a substitution item nor shall any substitution item be ordered, installed, or utilized without the ENGINEER'S prior written acceptance of the CONTRACTOR'S "Substitution Request Form."
 7. The ENGINEER will record the time required by the ENGINEER in evaluating substitutions proposed by the CONTRACTOR and in making changes by the CONTRACTOR in the Contract Documents occasioned thereby.
- C. The CONTRACTOR's application shall address the following factors which will be considered by the ENGINEER in evaluating the proposed substitution:
1. Whether the evaluation and acceptance of the proposed substitution will prejudice the CONTRACTOR's achievement of Substantial Completion on time.
 2. Whether acceptance of the substitution for use in the WORK will require a change in any of the Contract Documents to adapt the design to the proposed substitution.
 3. Whether incorporation or use of the substitution in connection with the WORK is subject to payment of any license fee or royalty.
 4. Whether all variations of the proposed substitution from the items originally specified are identified.
 5. Whether available maintenance, repair, and replacement service are indicated. The manufacturer shall have a local service agency (within 50 miles of the site) which maintains properly trained personnel and adequate spare parts and is able to respond and complete repairs within 24 hours.
 6. Whether an itemized estimate is included of all costs that will result directly or indirectly from acceptance of such substitution, including cost of redesign and claims of other contractors affected by the resulting change.
 7. Whether the proposed substitute item meets or exceeds the experience and/or equivalency requirements listed in the appropriate technical specifications.
- D. Without any increase in cost to the OWNER, the CONTRACTOR shall be responsible for and pay all costs in connection with proposed substitutions and of inspections and testing of equipment or materials submitted for review prior to the CONTRACTOR's purchase thereof for incorporation in the WORK, whether or not the ENGINEER accepts the proposed substitution or proposed equipment or material. The CONTRACTOR shall reimburse the OWNER for the charges of the ENGINEER for evaluating each proposed substitution.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 01 74 30 - PRESSURE PIPE TESTING

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall test water pipelines and appurtenant piping, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. **Furnish:**
 - 1. A testing plan and schedule, including method for water conveyance, control, and disposal shall be submitted in writing for approval.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. All test equipment, temporary valves, bulkheads, and other water control equipment shall be as determined by the CONTRACTOR. No materials shall be used which would be injurious to the WORK.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Water for testing water pipelines will be furnished by the CONTRACTOR and the CONTRACTOR shall convey the water from the designated source to the points of use.
- B. All pressure pipelines shall be tested. All testing operations shall be performed in the presence of the ENGINEER.
- C. Disposal of flushing water shall be by methods acceptable to the ENGINEER.

3.2 HYDROSTATIC TESTING OF PIPELINES

- A. Pipeline 30-inches diameter and larger shall be visually inspected that all debris has been removed prior to flushing.
- B. Prior to hydrostatic testing, pipelines shall be flushed or blown out as appropriate. The CONTRACTOR shall test pipelines in sections. Sections to be tested shall be defined by isolation valves in the pipeline. Where such valves are not present, the CONTRACTOR shall install temporary bulkheads or plugs for the purpose of testing. Sections that do not have isolation valves shall be tested in approximate 1,000-foot segments. Sections that have a zero-leakage allowance may be tested as a unit. No section of the pipeline shall be tested until field-placed concrete or mortar has attained

an age of 14 Days, where applicable. The test shall be made by closing valves when available or by placing bulkheads and filling the line slowly with water. The CONTRACTOR shall be responsible for ascertaining that test bulkheads are suitably restrained to resist the thrust of the test pressure without damage to or movement of the adjacent pipe. Unharnessed sleeve-type couplings, expansion joints, or other sliding joints shall be restrained or suitably anchored prior to the test to avoid movement and damage to piping and equipment. Remove or protect any pipeline-mounted devices that may be damaged by the test pressure. The CONTRACTOR shall provide sufficient temporary tappings in the pipelines to allow for trapped air to exit. After completion of the tests, such taps shall be permanently plugged. Care shall be taken that air relief valves are open during filling.

- C. The pipeline shall be filled at a rate which will not cause any surges or exceed the rate at which the air can be released through the release valves at a reasonable velocity. The air within the pipeline shall be allowed to escape completely. The differential pressure across the orifices in the air release valves shall not be allowed to exceed 5 psi at any time during filling. After the pipeline or section thereof has been filled, it shall be allowed to stand under static head pressure for at least 24 hours to allow the concrete or mortar lining, as applicable, to absorb water and to allow the escape of air from air pockets. During this period, bulkheads, valves, and connections shall be examined for leaks. If leaks are found, corrective measures satisfactory to the ENGINEER shall be taken.
- D. The hydrostatic test shall consist of holding the indicated test pressure on the pipeline segment for a period of 4 hours. The test pressure for yard piping shall be as indicated on the Piping Schedule measured at the lowest point of the pipeline section being tested. Visible leaks that appear during testing shall be repaired in a manner acceptable to the ENGINEER. Add water to restore the test pressure if the pressure decreases 5-psi below test pressure during the test period.
- E. The maximum leakage for yard piping shall be as indicated on the Piping Schedule. Pipe with welded joints shall have no leakage. Exposed piping shall show no visible leaks and no pressure loss during the test. In the case of pipelines that fail to pass the leakage test, the CONTRACTOR shall determine the cause of the leakage, shall take corrective measures necessary to repair the leaks, and shall again test the pipeline, repeating as necessary until the pipeline passes.

- END OF SECTION -

SECTION 01 75 00 - STARTUP

PART 1 -- GENERAL

1.1 GENERAL

- A. Plant startup is prerequisite to satisfactory completion of the contract requirements and shall be completed within the Contract Times.
- B. Conduct all test, check out, startup, and related requirements indicated in the Contract Documents and provide documentation of same to the ENGINEER prior to requesting Substantial Completion from the ENGINEER. Where manufacturer onsite inspections are required before startup, the manufacturer shall furnish a written statement that the installation and check out is complete and proper and that the item(s) are ready for startup
- C. Startup of a fish hatchery is a complex operation requiring the combined expertise of the CONTRACTOR, Subcontractors, the ENGINEER, the OWNER, and OPERATOR. The CONTRACTOR shall be responsible for coordinating all parties for a successful startup: the ENGINEER, OWNER, and OPERATOR will be available for technical and operational advice prior to and during startup.
- D. General requirements for startup activities are included in this Section. More specific requirements may also be included in other portions of the Contract Documents.
- E. Temporary facilities may be necessary. If so, CONTRACTOR shall design, provide, operate, and later decommission them.
- F. During startup, effluent shall be discharged to Fall Creek via the fish ladder. If pollutants are laden within the effluent, flow shall be directed to the settling ponds.

1.2 DEFINITIONS

- A. Startup is defined as testing, demonstrations, and other activities as required to achieve Substantial Completion. Startup includes pre-commissioning and commissioning activities, manufacturer's services, certifications of readiness for testing, and troubleshooting, checkout, and shakedown activities.
- B. Pre-commissioning is the systematic demonstration through testing and extended operation that major equipment and auxiliary systems, including related components, sub-systems, and systems operate properly and consistent with their intended function. Pre-commissioning involves balancing, adjustments, calibration, loop checks, and loop validation. Pre-commissioning shall simulate shutdown conditions, failure conditions, power fail and restart, bypass conditions, and failure resets. Pre-commissioning will not be considered complete until successful results and documentation of tests and manufacturer's certifications required by the Contract Documents are submitted and accepted by the ENGINEER. Pre-commissioning of all portions of the WORK shall be successfully completed prior to starting Commissioning.
- C. Commissioning is the verification that the complete WORK functions on an extended basis in full conformance with the Contract requirements.

1.3 SUBMITTALS

- A. **Schedule:** The schedule for startup shall be submitted under Section 01 32 15 - CPM Construction Schedule.
- B. **Startup Plan:** Not less than 60 Days prior to startup, submit for review a detailed Startup Plan. The CONTRACTOR shall revise the Plan as necessary based on review comments. The Plan shall include:
1. Schedules for manufacturers' equipment certifications
 2. Schedules for submitting final Technical Manuals,
 3. Schedule for training the OPERATOR's personnel,
 4. Description of temporary facilities and schedule for installation and decommissioning them
 5. List of OWNER and CONTRACTOR-furnished supplies
 6. Detailed schedule of operations to achieve successful pre-commissioning and commissioning.
 7. Checklists and data forms for each item of equipment
 8. Address coordination with the OPERATOR's staff.
 9. Designate a representative of the CONTRACTOR who has the authority to act in matters relating to startup. The Plan shall also designate the roles and responsibilities of any Subcontractors that may be involved in startup activities.
 10. Safety, startup, and testing procedures and proposed inspection and certification forms and records.
 11. Hydrostatic testing of water-holding structures and pipelines and other potable water equipment. Schedule and plan shall indicate source of water, and testing sequence.
- C. **Records and Documentation:**
1. Where required by the specifications, submit equipment installation certifications under those sections.
 2. Records of startup as indicated below.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 MALFUNCTIONS

- A. During the extended operational demonstrations, all components, subsystems, systems, and equipment must properly run continuously 24 hours per day at rates indicated by the ENGINEER throughout the test period. Unless indicated otherwise, if any item fails or malfunctions during the test, the item shall be repaired, and the test restarted at time zero with no credit given for the operating time before the failure or malfunction. Malfunctions satisfying all 3 of the following conditions will allow the demonstration period to resume at the elapsed time when the malfunction started:
1. Malfunction did not cause any interruption of the continuous operation of any other components, subsystems, systems, and equipment.
 2. Malfunction was corrected without causing or requiring any components, subsystems, systems, and equipment to cease operations.
 3. Malfunction was corrected within one hour of the time the malfunction was detected (the one-hour period includes the time required to locate the cause of the malfunction, beginning upon CONTRACTOR's notification from the ENGINEER that a malfunction has occurred and ending when the item is corrected and the system is successfully placed back into operation).
- B. The CONTRACTOR shall arrange for manufacturer's representatives to visit the Site as often as necessary to correct malfunctions.

3.2 PREREQUISITES

- A. Pre-commissioning and commissioning activities shall be scheduled according to Section 01 32 15. The 7 Day demonstrations and the 8 Day demonstration shall start prior to midday on a Monday, Tuesday, or Wednesday. Testing periods shall not include holidays, based on the OWNER's calendar.
- B. The following shall be completed before pre-commissioning begins.
1. All Technical Manual information required by the Contract Documents has been submitted.
 2. Safety equipment, emergency shower and eyewash units, fire extinguishers, gas detectors, protective guards and shields, emergency repair kits, safety chains, handrails, gratings, safety signs, and valve and piping identification required by the Contract Documents are provided. Devices and equipment shall be fully functional, adjusted, and tested.
 3. Manufacturer's certifications of proper installation have been accepted.
 4. Leakage tests, electrical tests, and adjustments have been completed.

5. The ENGINEER has approved the Startup Plan.
6. Temporary facilities are functional, adjusted, and ready for use.
7. Individual instrumentation loops (analog, status, alarm, and control) have been verified functionally.
8. Pressure switches, flow switches, timing relays, level switches, vibration switches, temperature switches, RTD monitors, pressure regulating valves, and other control devices to the settings determined by the ENGINEER or the equipment manufacturer have been adjusted for accuracy.
9. Individual interlocks between the field-mounted control devices and the motor control circuits, control circuits of variable-speed controllers, and packaged system controls have been verified.

3.3 GENERAL

A. **Supplies**

1. The CONTRACTOR shall furnish:
 - a. Fuel
 - b. Oil and grease
 - c. Other necessary materials not listed for the OWNER to furnish
2. The OWNER will furnish:
 - a. Power

B. **Startup Records:** The CONTRACTOR shall maintain the following during testing and startup and submit originals to ENGINEER:

1. Lubrication and service records for each mechanical and electrical equipment item
2. Hours of daily operation for each mechanical and electrical equipment item
3. Equipment alignment and vibration measurement records
4. Logs of electrical measurements and tests
5. Instrumentation calibration and testing logs
6. Testing and validation of SCADA inputs, outputs, logic functions, status indications, and alarms
7. Factory and field equipment settings
8. Log of problems encountered, and remedial action taken

9. Other records, logs, and checklists as required by the Contract Documents

3.4 PRE-COMMISSIONING

- A. After individual equipment items and subsystems have been tested and certified as required by the Technical Specifications, tests of systems comprised of single or multiple equipment items with appurtenant equipment and instruments and controls shall be conducted. Items of equipment shall be tested as part of a system to the maximum extent possible.
- B. Subject to the malfunction criteria above, each system shall be demonstrated for a continuous, 7 Day, 24 hour/day period. If any system malfunctions, the item or equipment shall be repaired, and the test restarted at time zero with no credit given for the elapsed time before the malfunction.
- C. The CONTRACTOR shall demonstrate the manual and automatic modes of operation to verify proper control sequences, software interlocks, proper operation of software logic and controllers, etc. System testing shall include the use of water or other process media, as applicable, to simulate the actual conditions of operation.
- D. Systems testing activities shall follow the detailed procedures and checklists in the Testing and Startup Plan. Completion of systems shall be documented by a report.
- E. The CONTRACTOR shall demonstrate utility, chemical feed, safety equipment, and other support systems before whole process systems.
- F. Furnish the ENGINEER at least 10 Days written notice confirming the start of pre-commissioning. The OPERATOR's staff will observe pre-commissioning.

3.5 COMMISSIONING

- A. The CONTRACTOR shall start up the plant and operate it without malfunction for a continuous 8 Day, 24 hour/day period. The ENGINEER will determine the operational parameters. CONTRACTOR must be aware that Section 40 90 00 adds a 22 Day performance test period after the commissioning period.
- B. Defects that appear shall be promptly corrected. Time lost for wiring corrections, control point settings, or other reasons that interrupt the test may, at the judgement of the ENGINEER, be cause for extending the demonstration an equal amount of time.
- C. Commissioning shall not begin until leakage tests, instrumentation tests and adjustments, electrical tests and adjustments, equipment field tests, and system tests have been completed to the satisfaction of the ENGINEER.
- D. During commissioning, the CONTRACTOR shall:
 - 1. Lubricate and maintain equipment in accordance with the manufacturers' recommendations.
 - 2. Clean or replace strainers, screens, and filter elements.

- END OF SECTION -

SECTION 01 77 00 - PROJECT CLOSEOUT

PART 1 -- GENERAL

1.1 FINAL CLEANUP

- A. The CONTRACTOR shall promptly remove from the vicinity of the completed WORK, all rubbish, unused materials, concrete forms, construction equipment, and temporary structures and facilities used during construction. Final acceptance of the WORK by the OWNER will be withheld until the CONTRACTOR has satisfactorily performed the final cleanup of the Site.

1.2 CLOSEOUT TIMETABLE

- A. The CONTRACTOR shall establish dates for equipment testing, acceptance periods, and on-site instructional periods (as required under the Contract). Such dates shall be established not less than one week prior to beginning any of the foregoing items, to allow the OWNER, the ENGINEER, and their authorized representatives sufficient time to schedule attendance at such activities.

1.3 TECHNICAL MANUAL SUBMITTAL

- A. The CONTRACTOR's attention is directed to the condition that one percent of the Contract Price will be retained from any monies due the CONTRACTOR as progress payments, if at the 75 percent construction completion point, the approved Technical Manual complying with Section 01 33 00 has not been submitted. The aforementioned amount will be retained by the OWNER as the agreed, estimated value of the approved Technical Manual. Any such retention of money for failure to submit the approved Technical Manual on or before the 75 percent construction completion point shall be in addition to the retention of any payments due to the CONTRACTOR under Article 14 of the General Conditions.

1.4 FINAL SUBMITTALS

- A. The CONTRACTOR, prior to requesting final payment, shall obtain and submit the following items to the ENGINEER for transmittal to the OWNER:
 - 1. Written guarantees, where required.
 - 2. Technical Manuals and instructions.
 - 3. New permanent cylinders and key blanks for all locks.
 - 4. Maintenance stock items; spare parts; special tools.
 - 5. Completed record drawings.
 - 6. Bonds for roofing, maintenance, etc., as required.
 - 7. Certificates of inspection and acceptance by local governing agencies having jurisdiction.

8. Releases from all parties who are entitled to claims against the subject project, property, or improvement pursuant to the provisions of law.

1.5 MAINTENANCE AND GUARANTEE

- A. The CONTRACTOR shall comply with the maintenance and guarantee requirements contained in Article 13 of the General Conditions.
- B. Replacement of earth fill or backfill, where it has settled below the required finish elevations, shall be considered as a part of such required repair work, and any repair or resurfacing constructed by the CONTRACTOR which becomes necessary by reason of such settlement shall likewise be considered as a part of such required repair work unless the CONTRACTOR shall have obtained a statement in writing from the affected private owner or public agency releasing the OWNER from further responsibility in connection with such repair or resurfacing.
- C. The CONTRACTOR shall make all repairs and replacements promptly upon receipt of written order from the OWNER. If the CONTRACTOR fails to make such repairs or replacements promptly, the OWNER reserves the right to do the WORK and the CONTRACTOR and its surety shall be liable to the OWNER for the cost thereof.

1.6 BOND

- A. The CONTRACTOR shall provide a bond to guarantee performance of the provisions contained in Paragraph "Maintenance and Guarantee" above, and Article 13 of the General Conditions.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION (NOT USED)

- END OF SECTION -

SECTION 02 15 00 - COFFERDAMS AND PROTECTIVE WORKS

PART 1 -- GENERAL

1.1 SUMMARY

- A. The WORK includes furnishing all design, labor, and equipment necessary to construct and maintain in good working order all cofferdams and protective works necessary during construction of facilities located in or adjacent to static or moving bodies of water as specified herein.
- B. All cofferdam and related protective work shall be located within the approved disturbance area limits as shown on the Contract Drawings.
- C. Remove all temporary cofferdams or other temporary protective works upon completion of the facilities located in or adjacent to bodies of water.

1.2 CONTRACTOR SUBMITTALS

- A. The CONTRACTOR shall submit a proposed plan for cofferdams and protective works in accordance with the requirements of Section 01 33 00 – Contractor Submittals which shall address, as a minimum, the following items:
 - 1. Type of cofferdam or other protective works to be used.
 - 2. Sequence of construction for cofferdam or other protective works-related Work items.
 - 3. Description of provisions for limiting siltation or other effects on the creek.
 - 4. Description of provisions for removal of temporary cofferdams or protective works and replacement or grading to design elevations shown on the Contract Documents following removal.
 - 5. Description of provisions for excavating and dewatering insides of the cofferdams or protective works, in accordance with Section 31 23 19 – Dewatering.
 - 6. Regulatory requirements for cofferdam and cofferdam-related activities.
 - 7. All calculations, assumptions, material properties, and other data required to substantiate the design of the cofferdam and protective works.
- B. The submittal shall be prepared and sealed by a Professional Engineer registered in the State of California experienced with cofferdam and related design.
- C. The plan shall be submitted for review a minimum of sixty (60) calendar days prior to beginning planned cofferdam work, shall be subject to review, permitting, and acceptance by governing authorities and the owners of any facilities utilized for water conveyance; as well as OWNER. However, these reviews shall not relieve the CONTRACTOR of full responsibility for the adequacy and stability of the cofferdams and protective works.

- D. Additionally, the CONTRACTOR shall submit a fish salvage plan concurrent with the cofferdam and protective works plan, describing:
 - 1. The anticipated order of activities for fish salvage operations behind the cofferdams prior to dewatering.
 - 2. The qualified, subcontracted biologists intended to carry out fish salvage operations.
 - 3. Equipment specifications intended for use in the fish salvage operations.

1.3 QUALIFICATIONS

- A. The CONTRACTOR shall demonstrate a minimum of ten (10) years' experience in the construction of shoring walls, in-water work, and cofferdams including, but not necessarily limited to experience with sheet piles, H piles, soldier pile walls, segmental (block) walls, earth fill cofferdams, and the associated planning, staging, and dewatering aspects thereof.

1.4 DEFINITIONS

- A. **Existing Ground.** The elevation of the existing ground surface before construction (including existing ground surfaces under water).
- B. **Finish Grade.** Represents the grade required by the Contract Documents to be the finished ground surface upon completion of construction.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. The type of construction used for cofferdams or other protective works (e.g., double-walled sheetpile cofferdams, tremie concrete, construction concrete block, or sandbag cofferdam) shall be at the choice of the CONTRACTOR, provided that the selected alternative fulfills the requirements of project permits and the Contract Documents. Cofferdam designs, configurations, or staging sequences that are substantially different than those shown on the Contract Documents require the CONTRACTOR to submit alternate design concepts such that the design and ownership team can evaluate design and permitting impacts.
- B. Cofferdams or other protective works shall be constructed, maintained, and removed using materials and methods that do not produce siltation or other degradation of the water quality of the creek which exceeds the limits of applicable federal, state, and local regulations.
- C. Cofferdams shall be designed and constructed of such a size that in no instance do they encroach within 10 feet of disturbed areas for other work.
- D. Sheet piling or any other methods requiring disturbance below original ground surface may not be used in any archeologically sensitive areas.

2.2 WOOD SHEETING

- A. Wood used for sheeting, shoring, and bracing will be sound; straight grained; free from shakes, loose knots, and other defects liable to impair its strength or durability; and will be Yellow Pine, Douglas Fir, or equivalent and will be either tongue-and-grooved or splined. Wood sheeting will not be less than nominal 2 inches thick.

2.3 STEEL SHEETING

- A. Steel sheeting will conform to ASTM A 328.

2.4 STRUCTURAL STEEL

- A. Temporary structural steel channels, angles, plates, and bars shall conform to ASTM A 36.
- B. Temporary structural steel W-Beams shall conform to ASTM A 992.
- C. Temporary structural steel rectangular HSS sections shall conform to ASTM A 500 Grade B.
- D. Temporary structural steel pipe sections shall conform to ASTM A 53 Grade B.

2.5 SANDBAGS IN WATER

- A. All temporary sandbags placed in water will conform to all applicable federal, state, and local laws and regulations.

2.6 CONSTRUCTION CONCRETE BLOCKS

- A. Construction concrete blocks shall be Ultrablock, Inc. or equivalent.

PART 3 -- EXECUTION

3.1 COFFERDAMS

- A. Cofferdams shall be designed by the CONTRACTOR and construction methods will be selected by the CONTRACTOR. The design of the cofferdams will take into account the range of creek elevations which can be expected during the time allowed for in-water construction. The CONTRACTOR shall review available flow records to make this determination.
- B. Once the cofferdam is installed, the CONTRACTOR shall coordinate with their subcontracted biologists to perform a fish salvage process. The salvage will remove fish from behind the cofferdam or between cofferdams to be released back into the river. This will allow the area between cofferdams or behind a cofferdam to be completely dewatered during the river low flow periods. The CONTRACTOR shall follow the fish salvage plan that has been submitted and approved by the OWNER or ENGINEER and CDFW. The general process is assumed to be as follows:
 - 1. Prior to the cofferdam installation the fish salvage team shall use electro-fishers on a very low setting (non-stunning and moving downstream), to herd without capture.

Once the cofferdam is constructed the fish salvage team shall begin multiple pass shocking whining confined area to stun and remove all species of fish encountered. Species expected to encounter shall be *O. mykiss*, sculpin, suckers, and lamprey.

2. Site evaluation on arrival (weather / air and water temperatures).
 3. All crew members participating will be outfitted with waterproof waders and rubber neoprene gloves to protect against electric shock.
 4. Prior to sampling, stream temperature and conductivity will be recorded and used to set electro-fisher parameters (voltage, frequency, pulse) to manufacturer's recommended guidelines.
 5. Two netters will collect stunned fish and hold them in a 5-gallon bucket with bubble aerator. Fish are allowed to fully recover in the bucket before release downstream of the removal area.
 6. The fish salvage team will record total number of salmonids handled (by spp.) and total mortality for reporting, which is required for the project permit.
 7. Upon completion of each fish salvage event, the fish salvage team shall provide a report outlining the process and summarize the activity along with tabulated results of fish captured.
- C. Cofferdam areas shall be dewatered such that the bottoms of the excavations within the cofferdams are firm, free of standing water, and in all respects acceptable to the OWNER as foundation. The dewatering methods used shall prevent boiling, quick conditions, or softening of foundation strata and shall maintain the bottom of the excavation in a condition so that every phase of the WORK can be performed in the dry, with the exception of in-water work related to cofferdams and protective works as specified in the Contract Documents. Dewatering shall be performed in accordance with the requirements of Section 31 23 19 - Dewatering.
- D. After construction, the cofferdams shall be removed after areas are graded to finished grade, where indicated, or otherwise returned to existing grades; however, removal of cofferdams will not occur prior to the installation and backfill of all buried utilities which lie within 30 feet of the cofferdam areas. If options have been selected with below grade construction, it may be possible to cut off the structures at grade if the CONTRACTOR obtains approval of the appropriate jurisdictional authority.
- E. Any loss of water and any damage to ground, structures, facilities, fishery resources, or any other existing items that may be affected by the CONTRACTOR'S cofferdam operations, shall be the responsibility and liability of the CONTRACTOR and will be repaired or restored by the CONTRACTOR as required, to the OWNER'S satisfaction. Any damage or injury to a person directly or indirectly caused by the CONTRACTOR'S cofferdam operations shall be the responsibility of the CONTRACTOR.
- F. It is the CONTRACTOR's responsibility to design, install, and maintain functionally effective and structurally sound cofferdams. The failure of the cofferdam either in function or structurally for any reason, subsurface conditions inclusive, and the consequences of such a failure and liability for such a failure, will be the responsibility of the CONTRACTOR.

In the event the cofferdam has failed or is not functional as designed, the CONTRACTOR shall repair or rebuild the cofferdam at no additional cost to OWNER. Repairs or modifications to the cofferdams require additional design and construction submittals subject to the requirements of the Cofferdams and Protective Works Plan shown in this specification.

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SECTION 02 22 00 - SITE CONDITION ASSESSMENT

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall conduct thorough pre-construction and post-construction Site conditions surveys of the entire Project. Site conditions surveys shall consist of photographs, videotape recordings, and topographic mapping.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with the requirements of Section 01 33 00 - Contractor Submittals.
- B. Videotape surveys, photographs, and other data of the preconstruction conditions shall be submitted to the ENGINEER for record purposes prior to, but not more than three weeks before, commencement of any construction activities.
- C. Except as otherwise indicated, post-construction topographic mapping shall be submitted to the ENGINEER within 60 days of completing WORK.
- D. A complete set of all photographs and survey data of the post-construction conditions shall be completed and submitted prior to final inspection by the OWNER and ENGINEER.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 PHOTOGRAPHS AND VIDEO RECORDINGS

- A. CONTRACTOR, as a minimum, shall document pre- and post-construction conditions by preparing videotape surveys of the following:
 - 1. Roadways used to access the Site or haul materials and equipment to the Site.
 - 2. Work areas, including actual work sites, materials processing and stockpiling areas, access corridors, disposal areas, and staging areas.
 - 3. The existing lower raceway bank concrete slab, as shown on the Contract Drawings.
 - 4. Any work completed by other contractors at the Site that will be connected to or otherwise affected by the WORK.
- B. Supplement videotape surveys with photographs and spot elevation surveys as required to thoroughly document the original condition and location of existing features and facilities.

- C. Videotape records shall be MP4 format.

3.2 TOPOGRAPHIC MAPPING

- A. Topographic mapping shall be developed using the Project coordinates, shall be referenced to the Project base lines and benchmarks, and shall be adequate to ascertain pre-construction and post-construction elevations of all public and private property within and adjacent to the construction limits.
- B. Topographic mapping shall be conducted to document the pre-construction topography of the Site:
 - 1. The existing upper raceway bank and outlet structure shall be surveyed as required to accurately depict the location, shape, and elevations of all walls, floor slabs, and the surrounding grade.
 - 2. The existing lower raceway bank and outlet structure shall be surveyed as required to accurately depict the location, shape, and elevations of all walls, floor slabs, pipes, sidewalks, structures, and the surrounding grade.
 - 3. The existing Dam A and Dam B shall be surveyed as required to accurately depict the location, shape, and elevations of the structures.
- C. Topographic mapping shall be conducted to document the post-construction topography of the Site:
 - 1. All areas of earthworks performed on site shall be surveyed in sufficient detail for accurate representation in the survey.
 - 2. All buildings and structures shall be surveyed in sufficient detail for accurate representation, including all foundations, tops of walls, concrete breaklines, appurtenances (e.g. bollards, fencing, etc.), and surrounding grade.
 - 3. All ponds and raceways shall be surveyed in sufficient detail for accurate representation, including floor slabs, concrete breaklines, pipe inverts, appurtenances (e.g. bollards, fencing, etc.), and surrounding grade.
 - 4. Modifications to Dams A and B shall be surveyed in sufficient detail for accurate representation, including concrete slabs, walls, gates, pipes, junctions with existing concrete, and surrounding grade.
- D. Spot elevation surveys used to document the elevation on abutting roadways, drives, and walks shall be taken at approximately 20-foot intervals and at the point of juncture with any structure to which they are attached or otherwise influenced by the WORK.
- E. All pre- and post-construction topographic mapping and other data, including spot elevations, shall be prepared and sealed by a Professional Land Surveyor.
- F. All pre- and post-construction survey data shall be furnished as follows:

1. Site mapping shall be submitted as a separate electronic drawing in AutoCAD 2010 (Release 24), or later.
2. Each AutoCAD site map shall also be submitted in hard copy plot format (six copies).
3. ENGINEER will review hardcopy plots for accuracy relative to the indicated requirements.
4. CONTRACTOR shall amend mapping files as required, based on ENGINEER's comments.
5. The electronic mapping files shall be produced using field survey techniques with sufficient accuracy for reproduction and use as base maps at a scale of 1"=20' horizontal and 1-foot contour intervals as specified for National Map Accuracy Standards.
6. Electronic mapping files shall be three-dimensional.
7. Submit points lists for all topographic surveys in ASCII text file format.
8. All files shall be submitted as an electronic deliverable in a format and by a means acceptable by CONSTRUCTION MANAGER.
9. A backup of the files shall be made on two flash drives which shall be submitted to the OWNER and ENGINEER, respectively.

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SECTION 02 41 00 - DEMOLITION, SALVAGE, AND REHABILITATION

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall demolish and reconstruct existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation facilities as indicated, in accordance with the Contract Documents.

1.2 COORDINATION

- A. The CONTRACTOR shall carefully coordinate the WORK in areas where existing facilities are interconnected with new facilities and where existing facilities remain operational. The WORK as indicated is not all inclusive, and the CONTRACTOR shall be responsible to perform the reconstruction indicated plus that which can be reasonably inferred from the Contract Documents as necessary to complete the Project. The Specifications and Drawings identify the major facilities that shall be demolished and reconstructed, but auxiliary utilities such as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily shown.
- B. The CONTRACTOR shall note that the Drawings used to indicate demolition and reconstruction are based on record drawings of the existing facilities. These record drawings have been reproduced to show existing conditions and to clarify the scope of WORK as much as possible. Prior to bidding, the CONTRACTOR shall conduct a comprehensive survey at the Site to verify the correctness and exactness of the Drawings, the scope of WORK, and the extent of auxiliary utilities. Existing hatchery water line locations are unknown but shall be demolished to accommodate new yard piping. CONTRACTOR shall verify the location of the hatchery water supply pipelines prior to construction.
- C. The CONTRACTOR shall erect and maintain fences, warning signs, barricades, and other devices around the reconstruction as required for the protection of the CONTRACTOR's employees. The CONTRACTOR shall remove such protection when reconstruction activities are complete, or as work progresses, or when directed by the ENGINEER.

1.3 CONTRACTOR SUBMITTALS

- A. Demolition Plan: Demolition and reconstruction activities and procedures, including operational sequence, shall be submitted to the ENGINEER for approval. The procedures shall provide for safe conduct of the WORK, careful removal and disposition of materials and equipment, protection of existing facilities which are to remain undisturbed, coordination with existing facilities to remain in service, and timely disconnection and reconnection of utility services. The procedures shall include a detailed description and time schedule of the methods and equipment to be used for each operation and the sequence of operation. A storage plan for salvaged items shall be included. Plan shall include state certified disposal facility that will be utilized for demolished materials.

1.4 SITE CONDITIONS

- A. Locate existing services and underground structures that may affect the Work or may be damaged during demolition. Drawings or descriptions, verbal or otherwise, of existing structures or their location that are given are intended only as an aid to the location of these structures. Measurements and locations of the existing underground structures shown on the Drawings are not guaranteed to be accurate and must be verified by the Contractor prior to proceeding with demolition.
- B. Unknown Conditions
 - 1. Material, debris, and soils may be contaminated by hazardous substances not indicated on the Drawings or Contract Documents. Conduct an assessment to classify the extent of contaminated materials.
- C. Lead-based paint and asbestos:
 - 1. Structures, equipment, and buildings to be removed may include lead-based paint and asbestos. Lead-based paint and asbestos shall be removed prior to general demolition.

1.5 DEMOLITION

- A. Existing pavement, structures, equipment, piping, valves, ductwork, electrical gear, instrumentation, utilities, and related appurtenances such as anchors, supports, and hardware indicated or required to be demolished as part of the WORK shall be removed and disposed of unless otherwise indicated. Removal of buried structures, utilities, and appurtenances includes the related excavation and backfill as required. Removed items shall be disposed of offsite by the CONTRACTOR.
- B. Items to be removed include:

Item	Description
Water Supply Flume	Demolish concrete water supply flume walls and slab, associated piping, intake screens and supports.
Storage Shed	Demolish and remove storage shed and concrete foundation.
Upper Raceway Piping and Walkways	Demolish and remove steel walkway grating, supports, ladders, and PVC piping.
Lower Raceway Concrete	Demolish and remove concrete walls down to existing slab. Maintain existing concrete slab. Burn back existing rebar 2 inches below the surface.

Lower Raceway Piping	Demolish PVC piping.
Lower Raceway Outlet Structure	Demolish concrete outlet structure walls, slab, and piping.
Incubation Shed	Demolish and remove building and concrete foundation.
Dam A	Demolish and remove dam wall, complete dam footing and cutoff wall as shown on contract drawings.

1.6 SALVAGE

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances indicated to be salvaged shall be removed without any degradation in condition from that prior to removal. Salvaged items shall be stockpiled and protected on the Site at a location directed by the ENGINEER. The CONTRACTOR shall be responsible to properly safeguard the salvaged items against damage and loss during removal and handling.
- B. Items to be salvaged include:

Item	Description
Automatic Transfer Switch	Includes salvaging Kohler 240V, 260A, NEMA 3R switch
Propane Standby Generator – Circuit Breaker	Includes salvaging Schneider Electric 250A, 240V, 3-phase, 25 kA SCCR circuit breaker

1.7 RELOCATION

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances required to be relocated shall be removed from the Iron Gate Fish Hatchery (IGFH) site without any degradation in condition from that prior to removal. The CONTRACTOR shall be responsible to properly safeguard the relocated items against damage and loss during removal, handling, storage, and installation in the new location.

Items to be relocated include:

Item	Description
IGFH Spawn Building - Electro Anesthesia Tank System	6 ft long X 2 ft wide X 29 in deep tank and control system. Includes relocation of hydraulic motor/pump, hydraulic valves/manifold, hoist controls, and tank

	guide rails.
IGFH Spawn Building – Fish Crowder	Includes relocation of crowder and motors, cable reel, raise/lower limit switches, upstream/downstream limit switches, motor starters, and controls.
IGFH Spawn Building - Sorting Table	6 feet long X 21 inches wide X 34 inches tall and 7-inch side rails on each side of table. Includes relocation of table, attachments, foot pedal safety switch, and controls on sidewall to operate electro anesthesia tank.
IGFH Spawn Building - Chutes	Chute going from sort table to holding table. Chute measurement 16 inches wide X 48 inches long. Chute going to conveyer belt is 24 inches wide X 6 feet long with 7-inch high side rails and one down the center to divide two separate chutes.
IGFH Spawn Building – Holding Table	Table is 4 feet wide X 5 feet long with 7-inch side rails on three sides of the table. Height of the table is 27 inches with adjustable legs.
IGFH Spawn Building – Air Spawn Table	Table is approximately 3 feet wide X 2 feet long. Includes relocation of table and appurtenant equipment.
IGFH Spawn Building – Conveyor Belt	Conveyor belt is 27 inches wide and connected in 10-foot segments. Includes relocation of (2) 10-foot segments of the frame, belt, motor, motor controls, and appurtenant equipment.
IGFH Spawn Building – Egg Rinse Table	Egg rinse and disinfecting area with a two-sided sink for rinsing eggs. Measurements are 8 feet long X 22 inches width X 34 inches tall. Includes relocation of table/sinks/frame and appurtenant components.
IGFH Spawn Building – Water Hardening Table	8 feet long X 29 inches wide X 27 inches tall. Includes relocation of table, supply and drainage manifold, and filters.
KRP Processing Table	Includes relocation of the processing table used by the Klamath River Project for testing and sampling.

Fish Screens	5'-0 3/8" x 4'-4" x 1 1/2". Qty – All.
Incubation Stacks	24 inches wide X 25" deep. Includes aluminum support frame and molded plastic trays. Qty – 142.
Propane Standby Generator	100 kW/125 kVA, 0.8 PF, 240V (reconfigurable to 480V), 3-phase, 4-wire. Includes relocation of entire generator skid with weatherproof enclosure.
Propane Tank	500-gallon. Includes relocation of tank.

1.8 ABANDONMENT

- A. Items of existing equipment, piping, valves, electrical gear, instrumentation, utilities, and appurtenances required to be abandoned shall be prepared by the CONTRACTOR as indicated.
- B. Items to be abandoned include:

Item	Description
Existing Water Supply Pipelines	The location of existing water lines on the Fall Creek Fish Hatchery site are unknown. Contractor shall demolish piping that is in interference with new infrastructure. Pipelines not exposed during construction activities may be abandoned in place.

1.9 REHABILITATION

- A. Existing civil, landscaping, structural, architectural, mechanical, HVAC, electrical, and instrumentation WORK disturbed or damaged by reconstruction activities shall be repaired and rehabilitated as indicated.
- B. Damaged items shall be repaired or replaced with new items to restore items or surfaces to a condition equal to and matching that existing prior to damage.

1.10 DISPOSAL

- A. The CONTRACTOR shall be responsible for the offsite disposal of debris resulting from reconstruction in compliance with local, state, and federal codes and requirements.

PART 2 -- PRODUCTS (NOT USED)

PART 3 -- EXECUTION

3.1 GENERAL

- A. The CONTRACTOR shall coordinate demolition and reconstruction WORK with the OWNER and ENGINEER. Unless otherwise indicated, the CONTRACTOR shall be responsible for the sequence of activities. WORK shall be performed in accordance with applicable safety rules and regulations.
- B. The CONTRACTOR shall verify that any utilities connected to structures, equipment, and facilities to be removed, relocated, salvaged, replaced, or abandoned are rendered inoperable, replaced with new utilities, or adequately bypassed with temporary utilities before proceeding with demolition and reconstruction.
- C. The CONTRACTOR shall take precautions to avoid damage to adjacent facilities and to limit the WORK activities to the extent indicated. If reconstruction beyond the scope indicated is required, the CONTRACTOR shall obtain approval from the ENGINEER prior to commencing.

3.2 ENVIRONMENTAL CONSIDERATIONS

- A. Dust and Debris Control:
 - 1. Dust from demolition and removal operations shall be controlled to not adversely affect people and equipment, including Others.
 - 2. Keep the site free of debris and control water runoff. Discharge water runoff such that is suspended with materials or other harmful substances in accordance with the requirements of local authorities. Prevent erosion and sedimentation per Specification Section 31 35 00 Erosion and Sediment Control General.
- B. Contain hazardous materials including dust, fibrous materials (insulation), contaminated or dangerous materials.

3.3 PROTECTION OF EXISTING FACILITIES

- A. Before beginning any reconstruction, the CONTRACTOR shall carefully survey the existing facilities and examine the Specifications and Drawings to determine the extent of reconstruction and coordination with the WORK. Existing facilities not subject to reconstruction shall be protected and maintained. Damaged existing facilities shall be repaired to the previous condition or replaced.
- B. Persons shall be afforded safe passages around areas of demolition.
- C. Structural elements shall not be overloaded. The CONTRACTOR shall be responsible for shoring, bracing, or adding new supports as may be required for adequate structural support as a result of WORK performed under this Section. The CONTRACTOR shall

remove temporary protection when the WORK is complete or when so authorized by the ENGINEER.

- D. The CONTRACTOR shall carefully consider bearing loads and capacities before placement of equipment and material on Site. In the event of any questions as to whether an area to be loaded has adequate bearing capacity, the CONTRACTOR shall consult with the ENGINEER prior to the placement of such equipment or material.

3.4 DEMOLITION, SALVAGE, AND RELOCATION

- A. The Contract Documents indicate existing facilities to be demolished, salvaged, and/or relocated. Auxiliary utilities including such services as water, air, chemicals, drainage, lubrication, fluid power, electrical wiring, controls, and instrumentation are not necessarily indicated. The CONTRACTOR shall verify the scope of the WORK to remove the equipment indicated; coordinate its shutdown, removal, replacement, or relocation. The removal of existing facilities for demolition, salvage, and relocation shall include the following requirements:
 - 1. Equipment supports, including concrete pads, baseplates, mounting bolts, and support hangers, shall be removed. Damage to the existing structure shall be repaired as indicated.
 - 2. Exposed piping including vents, drains, and valves shall be removed. Where exposed piping penetrates existing floors and walls, the piping, including wall thimbles, shall be removed to a minimum depth of 2-inches. Resultant openings in the structure shall be repaired as indicated.
 - 3. Electrical control panels, junction boxes, motor control centers, and local switches and pushbuttons shall be removed.
 - 4. Exposed electrical conduits and associated wiring shall be removed. Resultant openings in structures shall be repaired as indicated.
 - 5. Connections to embedded electrical conduits shall be removed a minimum of 2-inches inside the finished surface of the existing structure. Wiring shall be removed, and the resulting openings shall be repaired as indicated.
 - 6. Associated instrumentation devices shall be removed.
 - 7. Auxiliary utility support systems shall be removed.
 - 8. The area shall be thoroughly cleaned such that little or no evidence of the previous equipment installation will remain.
 - 9. Asphalt and concrete pavement, curbs, and gutters shall be removed as necessary to perform reconstruction. The limits of removal shall be sawcut. When the required improvements have been constructed, new asphalt and concrete pavement, curbs, and gutters shall be placed to match the original unless otherwise indicated.

10. Footings, foundation walls, below-grade construction and concrete slabs on grade shall be demolished and removed to a depth which will not interfere with new construction, but not less than 36-inches below existing ground surface or future ground surface, whichever is lower.
 11. Below-grade areas and voids resulting from demolition of structures shall be completely filled. Fill and compaction shall be in accordance with Section 31 00 00 - Earthwork. After fill and compaction, surfaces shall be graded to meet adjacent contours and to provide flow to surface drainage structures, or as indicated.
 12. When existing pipe is removed, the CONTRACTOR shall plug the resulting open ends whether or not so indicated. Where removed piping is exposed, the remaining piping shall be blind-flanged or fitted with a removable cap or plug.
 13. When existing piping is removed from existing structures, the CONTRACTOR shall fill resulting openings in the structures and repair any damage such that the finished rehabilitated structure shall appear as a new homogeneous unit with little or no indication of where the new and old materials join. The openings in water-bearing structures shall be filled with non-shrink grout to be watertight and reinforced as required or indicated. In locations where the surface of the grout will be exposed to view, the grout shall be recessed approximately 0.5-inch and the recessed area filled with cement mortar grout.
 14. Electrical reconstruction shall be conducted by the CONTRACTOR in a safe and proper manner to avoid injury from electrical shock to the OWNER's and CONTRACTOR's personnel. Electrical equipment to be shut off for a period of time shall be tagged, locked out, and sealed with a crimped wire and lead seal and made inoperable. At no time shall electrical wiring or connections which are energized or could become energized be accessible to CONTRACTOR, OWNER, or other personnel without suitable protection or warning signs.
- B. The CONTRACTOR shall perform a functional test of existing equipment that is relocated and reinstalled to ensure the equipment functions in the manner documented during the initial inspection. The CONTRACTOR shall inform the ENGINEER in writing a minimum of 5 Days prior to the functional testing in order for the OWNER and ENGINEER to witness the test. If, in the opinion of the ENGINEER, the relocated equipment does not function in a satisfactory manner, the CONTRACTOR shall make repairs and modifications necessary to restore the equipment to its original operating condition at no additional cost to the OWNER.

3.5 ABANDONMENT

- A. Existing facilities to be abandoned shall be prepared as indicated. Where existing buried piping is to be abandoned, the CONTRACTOR shall remove the abandoned pipe for a distance of 5-feet from any connecting structures. Openings at the existing structures shall be repaired. The remaining pipe shall be capped at both ends prior to backfill.

Buried piping, 12-inches diameter or greater shall be completely sand-filled prior to closure of the piping ends.

3.6 REHABILITATION

- A. Certain areas of existing structures, piping, conduits, and the like will be affected by WORK necessary to complete modifications under this Contract. The CONTRACTOR shall be responsible to rehabilitate those areas affected by its construction activities.
- B. Where new rectangular openings are to be installed in concrete or concrete masonry walls or floors, the CONTRACTOR shall score the edges of each opening (both sides of wall or floor slab) by saw-cutting clean straight lines to a minimum depth of 1-inch and then chipping out the concrete. Alternately, the sides of the opening (not the corners) may be formed by saw cutting completely through the slab or wall. Saw cuts deeper than 1-inch (or the depth of cover over existing reinforcing steel, whichever is less) shall not be allowed to extend beyond the limits of the opening. Corners shall be made square and true by a combination of core drilling and chipping or grinding. Necessary precautions shall be taken during removal of concrete to prevent debris from falling into or entering adjacent tanks in service or from damaging adjacent equipment or piping. Saw cuts allowed to extend beyond the opening shall be repaired by filling with non-shrink grout. The concrete around any exposed reinforcement steel shall be chipped back and exposed reinforcement steel cut a minimum of 2-inches from the finished face of the new opening and be painted with epoxy paint. The inside face of the new opening shall be grouted with an epoxy cement grout to fill any voids and cover the exposed aggregate and shall be trowel-finished to provide a plumb and square opening.
- C. Where new piping is installed in existing structures, the CONTRACTOR shall accurately position core-drilled openings in the concrete as indicated or otherwise required. Openings shall be of sufficient size to permit a final alignment of pipelines and fittings without deflection of any part and to allow adequate space for satisfactory packing where pipe passes through the wall to provide watertightness around openings so formed. The boxes or cores shall be provided with continuous keyways to hold the filling material in place, and they shall have a slight flare to facilitate grouting and the escape of entrained air during grouting. Before placing the non-shrink grout, concrete surfaces shall be sandblasted, thoroughly cleaned of sand and any other foreign matter, and coated with epoxy bonding compound.
- D. Pipes, castings, or conduits shall be grouted in place by pouring in grout under a head of at least 4-inches. The grout shall be poured or rammed or vibrated into place to fill completely the space between the pipes, castings, or conduits, and the sides of the openings so as to obtain the same watertightness as through the wall itself. The grouted casings shall then be water cured.
- E. In locations where the surface of the grout will be exposed to view, the non-shrink grout shall be recessed approximately 0.5-inch and the recessed area filled with cement mortar grout.
- F. When new piping is to be connected to existing piping, the existing piping shall be cut square and ends properly prepared for the connection. Any damage to the lining and coating of the existing piping shall be repaired. Dielectric insulating joints shall be installed at interconnections between new and existing piping.

- G. Where existing equipment, piping, and supports, electrical panels and devices, conduits, and associated appurtenances are removed, the CONTRACTOR shall rehabilitate the affected area such that little or no evidence of the previous installation remains. Openings in concrete floors, walls, and ceilings from piping, conduit, and fastener penetrations shall be filled with non-shrink grout and finished to match the adjacent area. Concrete pads, bases associated with equipment, supports, and appurtenances shall be removed by chipping away concrete and cutting any exposed reinforced steel and anchor bolts a minimum of 2-inches below finished grade and be painted with epoxy paint. The area of concrete to be rehabilitated shall be scored by saw cutting clean, straight lines to a minimum depth of 1.5-inches, and concrete within the scored lines removed to a depth of 1.5-inches (or the depth of cover over reinforcing steel, whichever is less). The area within the scored lines shall be patched with non-shrink grout to match the adjacent grade and finish. Abandoned connections to piping and conduits shall be terminated with blind flanges, caps, and plugs suited for the material, type, and service of the pipe or conduit.
- H. Existing reinforcement to remain in place shall be protected, cleaned, and extended into new concrete. Existing reinforcement not to be retained shall be cut-off as follows:
 - 1. Where new concrete joins existing concrete at the removal line, reinforcement shall be cut-off flush with the concrete surface at the removal line.
 - 2. Where the concrete surface at the removal line is the finished surface, the reinforcement shall be cut back 2-inches below the finished concrete surface, the ends painted with epoxy paint and the remaining holes patched with a cement mortar grout.
- I. Where existing handrailing is removed, post embedments and anchors shall be removed, and post holes shall be filled with non-shrink grout flush to the floor surface. At the point of continuation of existing handrailing, a new post with rail connections matching the existing handrailing system shall be installed. New posts in existing concrete floors shall be installed in core-drilled socket holes and the annular space between the post and hole filled with non-shrink grout.
- J. Where reconstruction activities damage the painting and coating of adjacent or nearby facilities, the damaged areas shall be surface prepared and coated in accordance with Section 09 96 00 - Protective Coatings to match the original painting and coating with a compatible system. Surfaces of equipment items that are to be relocated shall be prepared and be coated in accordance with Section 09 96 00 - Protective Coatings.

3.7 DISPOSAL

- A. Demolition and removal of debris shall minimize interference with roads, streets, walks, and other adjacent occupied or used facilities which shall not be closed or obstructed without permission from the OWNER. Alternate routes shall be provided around closed or obstructed traffic ways.
- B. Site debris, rubbish, and other materials resulting from reconstruction operations shall be legally removed and disposed of. Structures and equipment to be demolished shall be cleaned prior to demolition and the wash water properly disposed of. No trace of these

structures shall remain prior to placing of backfill in the areas from which structures were removed.

- C. Refuse, debris, and waste materials resulting from demolition and clearing operations shall not be burned.

3.8 OCCUPANCY AND POLLUTION CONTROL

- A. Water sprinkling, temporary enclosures, chutes, and other suitable methods shall be used to limit dust and dirt rising and scattering in the area. The CONTRACTOR shall comply with government regulations pertaining to environmental protection.
- B. Water shall not be used if it creates hazardous or objectionable conditions such as ice, flooding, or pollution.

3.9 CLEANING

- A. During and upon completion of WORK, the CONTRACTOR shall promptly remove tools and equipment, surplus materials, rubbish, debris, and dust and shall leave areas affected by WORK in a clean, approved condition.
- B. Adjacent structures shall be cleaned of dust, dirt, and debris caused by reconstruction, as directed by the ENGINEER or governing authorities, and adjacent areas shall be returned to condition existing prior to start of WORK.

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SECTION 03 11 13 - CONCRETE FORMWORK

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall furnish concrete formwork, bracing, shoring, and supports for cast-in-place concrete and shall design and construct falsework, all in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.
- B. Manufacturer's information demonstrating compliance with requirements for the following:
 - 1. Form ties and related accessories, including taper tie plugs.
 - 2. Form gaskets.
 - 3. Form release agent, including NSF certification if not using mineral oil.
 - 4. Manufacturer's information on formwork, form materials, and locations for use.
- C. **Shop Drawings:** Detailed plans for the fabrication and erection of falsework to be used. Such plans shall be in sufficient detail to indicate the general layout, sizes of members, anticipated stresses, grade of materials to be used in the falsework, means of protecting existing construction which supports falsework, and typical soil conditions. Include a list of form materials and locations for use.
- D. **Falsework Calculations and Drawings:** The CONTRACTOR's attention is directed to the provisions of Section 1717 of the Division of Industrial Safety, Construction Safety Orders, as revised November 1973, which requires that all falsework or vertical shoring installations where the height of the falsework or vertical shoring, as measured from the top of the sills to the soffit of the superstructure, exceeds 14-feet, or where individual horizontal span lengths exceed 16-feet, or provision for vehicular or railroad traffic through falsework or vertical shoring is made, shall be approved and signed by a Professional Engineer, registered in the State in which the falsework or vertical Shoring is to be used; provided further, that a copy of the falsework plan or shoring layout shall be available on the Site at all times.

1.3 QUALITY CONTROL

- A. **Tolerances:** The variation from required lines or grade shall not exceed 1/4-inch in 10-feet, non-cumulative, and there shall be no offsets or visible waviness in the finished surface. Other tolerances shall be within the tolerances of ACI 117 - Standard Tolerances for Concrete Construction and Materials

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Except as otherwise expressly accepted by the ENGINEER, lumber brought on the Site for use as forms, shoring, or bracing shall be new material. Forms shall be smooth surface forms and shall be of the following materials:

Walls	Steel, fiberglass, or plywood panel
Columns	Steel, plywood or fiberglass
Roof and floor	Plywood
All other WORK	Steel panels, fiberglass, plywood or tongue and groove lumber

- B. **NSF-61 Compliance.** Form materials that may remain or leave residues on or in the concrete shall be certified as compliant with NSF Standard 61 – Drinking Water System Components.

2.2 FORM AND FALSEWORK MATERIALS

- A. **Materials.** Materials for concrete forms, formwork, and falsework shall conform to the following requirements:
1. Lumber shall be Douglas Fir or Southern Yellow Pine, construction grade or better, in conformance with U.S. Product Standard PS 20 - American Softwood Lumber Standard
 2. Plywood for concrete formwork shall be new, waterproof, synthetic resin bonded, exterior type Douglas Fir or Southern Yellow Pine plywood manufactured especially for concrete formwork, shall conform to the requirements of PS 1 – Construction and Industrial Plywood, for Concrete Forms, Class I, and shall be edge sealed.
 3. Form materials shall be metal, wood, plywood, or other material that will not adversely affect the concrete and will facilitate placement of concrete to the shape, form, line, and grade indicated. Metal forms shall accomplish such results. Wood forms for surfaces to be painted shall be Medium Density Overlaid plywood, MDO Ext. Grade.
 4. Steel leave in place forms shall not be used.
- B. **Chamfer Edges.** Unless otherwise indicated, exterior corners in concrete members shall be provided with 3/4-inch chamfers or be tooled to 0.5-inch radius. Re-entrant corners in concrete members shall not have fillets unless otherwise indicated.
- C. **Load Criteria.** Forms and falsework to support the roof and floor slabs shall be designed for the total dead load, plus a live load of 50-psf minimum. The minimum design load for combined dead and live loads shall be 100-psf.

2.3 FORM TIES

- A. Form ties shall be provided with a plastic cone or other suitable means for forming a conical hole to ensure that the form tie may be broken off back of the face of the concrete. The maximum diameter of removable cones for rod ties or other removable form tie fasteners having a circular cross-section shall not exceed 1.5 inches; and all such fasteners shall be such as to leave holes of regular shape for reaming. Form ties for water-retaining structures shall have integral waterstops that tightly fit the form tie so that they cannot be moved from mid-point of the tie. Form ties shall be **ST Snap Ties** by **MeadowBurke**; **A3 Snap Ties** by **Dayton Superior**, or approved equal.
- B. Taper ties shall be installed with the larger diameter installed on the inside face of water holding basins or side of wall with the greater water pressure. For dry building, taper ties shall be installed with larger diameter opening at the soil side of wall. After removal a preformed neoprene or polyurethane tapered plug sized to seat within the wall shall be inserted in the hole left by the removal of the taper tie for all walls exposed to retained soil or water. Plugs shall be recessed a minimum of 1.5-inches from the face of wall. All holes shall then be drypacked with grout unless approved otherwise by Engineer. Use **Taper Ties** by **MeadowBurke**, **D9 Taper Ties** by **Dayton Superior**, or approved equal.

2.4 FINISHING CONCRETE SURFACES

- A. **Formed Surfaces:** No treatment is required after form removal except for curing, repair of Defective concrete, and treatment of surface defects.
 - 1. Surface holes larger than 1/2-inch in diameter or deeper than 1/4-inch are defined as surface defects in basins and exposed walls.
 - 2. Basins and exposed walls shall be given a smooth finish as indicated below.
 - 3. Basins and exposed walls shall be given 2 coats of cement-based coating as indicated.

PART 3 -- EXECUTION

3.1 GENERAL

- A. **Design Responsibility.** Forms to confine the concrete and shape it to the required lines shall be used wherever necessary. The CONTRACTOR shall assume full responsibility for the adequate design of forms, and any forms that are unsafe or inadequate in any respect shall promptly be removed from the WORK and replaced.
 - 1. A sufficient number of forms of each kind shall be available to permit the required rate of progress to be maintained.
 - 2. Provide worker protection from protruding reinforcement bars in accordance with applicable safety codes.
 - 3. The design and inspection of concrete forms, falsework, and shoring shall comply with applicable local, state, and Federal regulations.

4. Plumb and string lines shall be installed before concrete placement and shall be maintained during placement. Such lines shall be used by CONTRACTOR's personnel and by the ENGINEER and shall be in sufficient number and properly installed. During concrete placement, the CONTRACTOR shall continually monitor plumb and string line form positions and immediately correct deficiencies.
- B. **Quality Control & Bracing.** Concrete forms shall conform to the shape, lines, and dimensions of members required, and shall be substantial, free from surface defects, and sufficiently tight to prevent leakage. Forms shall be properly braced or tied together to maintain their position and shape under a load of freshly placed concrete. If adequate foundation for shores cannot be secured, trussed supports shall be provided.
- C. All forms shall be removed, after the appropriate curing times have been obtained, unless approved otherwise by the ENGINEER.

3.2 FORM DESIGN

- A. Forms shall be true in every respect to the required shape and size, shall conform to the established alignment and grade, and shall be of sufficient strength and rigidity to maintain their position and shape under the loads and operations incident to placing and vibrating the concrete. Suitable and effective means shall be provided on forms for holding adjacent edges and ends of panels and sections tightly together and in accurate alignment so as to prevent the formation of ridges, fins, offsets, or similar surface defects in the finished concrete.
1. Plywood, 5/8-inch and greater in thickness, may be fastened directly to studding if the studs are spaced close enough to prevent visible deflection marks in the concrete.
 2. The forms shall be tight so as to prevent the loss of water, cement, and fines during placing and vibrating of the concrete. Specifically, the bottom of wall forms that rest on concrete footings or slabs shall be provided with a gasket to prevent loss of fines and paste during placement and vibration of concrete. Such gasket may be a 1.0- to 1.5-inch diameter polyethylene rod held in position to the underside of the wall form.
 3. Adequate clean-out holes shall be provided at the bottom of each lift of forms. The size, number, and location of such clean-outs shall be as acceptable to the ENGINEER.
 4. Whenever concrete cannot be placed from the top of a wall form in a manner that meets the requirements of the Contract Documents, form windows shall be provided in the size and spacing needed to allow placement of concrete to the requirements of Section 03 30 00 - Cast-in-Place Concrete. The size, number, and location of such form windows shall be as acceptable to the ENGINEER.

3.3 CONSTRUCTION

- A. **Vertical Surfaces:** Vertical surfaces of concrete members shall be formed, except where placement of the concrete against the ground is indicated. Not less than 1-inch of concrete shall be added to the indicated thickness of a concrete member where concrete

is permitted to be placed against trimmed ground in lieu of forms. Permission to do this on other concrete members will be granted only for members of comparatively limited height and where the character of the ground is such that it can be trimmed to the required lines and will stand securely without caving or sloughing until the concrete has been placed.

- B. **Construction Joints:** Concrete construction joints will not be permitted at locations other than those indicated, except as may be acceptable to the ENGINEER. When a second lift is placed on hardened concrete, special precautions shall be taken in the way of the number, location, and tightening of ties at the top of the old lift and bottom of the new to prevent any unsatisfactory effect whatsoever on the concrete. Pipe stubs and anchor bolts shall be set in the forms where required.

C. **Form Ties**

1. **Embedded Ties:** Holes left by the removal of form tie cones shall be reamed with suitable toothed reamers so as to leave the surface of the holes clean and rough before being filled with mortar. Wire ties for holding forms will not be permitted. No form-tying device or part thereof, other than metal, shall be left embedded in the concrete. Ties shall not be removed in such manner as to leave a hole extending through the interior of the concrete members. The use of snap-ties that cause spalling of the concrete upon form stripping or tie removal will not be permitted. If steel panel forms are used, rubber grommets shall be provided where the ties pass through the form in order to prevent loss of cement paste. Where metal rods extending through the concrete are used to support or to strengthen forms, the rods shall remain embedded and shall terminate not less than 1-inch back from the formed face or faces of the concrete.
2. **Removable Ties:** The larger end of the taper tie shall be on the wet side of walls in water retaining structures. After the taper tie is removed, the hole shall be thoroughly cleaned and roughened for bond. A precast neoprene or polyurethane tapered plug shall be located at the wall centerline. The hole shall be completely filled with non-shrink grout for water bearing and below-grade walls. The hole shall be completely filled with non-shrink or regular cement grout for above-grade walls that are dry on both sides. Exposed faces of walls shall have the outer 2-inches of the exposed face filled with a cement grout that shall match the color and texture of the surrounding wall surface.

3.4 REUSE OF FORMS

- A. Forms may be reused only if in good condition and only if acceptable to the ENGINEER. Light sanding between uses will be required wherever necessary to obtain uniform surface texture on exposed concrete surfaces. Exposed concrete surfaces are defined as surfaces which are permanently exposed to view. In the case of forms for the inside wall surfaces of hydraulic/water retaining structures, unused tie rod holes in forms shall be covered with metal caps or shall be filled by other methods acceptable to the ENGINEER.

3.5 REMOVAL OF FORMS

- A. Careful procedures for the removal of forms shall be strictly followed, and this WORK shall be done with care so as to avoid injury to the concrete. No heavy loading on green concrete will be permitted.
 - 1. For roof slabs and above-ground floor slabs, forms shall remain in place until test cylinders for the roof concrete attain a minimum compressive strength of 75 percent of the 28 Day strength in Section 03 30 00 - Cast-in-Place Concrete. No forms shall be disturbed or removed under an individual panel or unit before the concrete in the adjacent panel or unit has attained 75 percent of the 28 Day strength and has been in place for a minimum of 7 Days. The time required to establish said strength shall be as determined by the ENGINEER who will make several test cylinders for this purpose from concrete used in the first group of roof panels placed. If the time so determined is more than the 7 Day minimum, then that time shall be used as the minimum length of time.
 - 2. For vertical walls of water holding structures, forms shall remain in place at least 36 hours after the concrete has been placed.
 - 3. For parts of the WORK not specifically mentioned herein, forms shall remain in place for periods of time as recommended in ACI 347 - Guide to Formwork for Concrete.

3.6 MAINTENANCE OF FORMS

- A. **General Condition.** Forms shall be maintained in good condition, particularly as to size, shape, strength, rigidity, tightness, and smoothness of surface. Before concrete is placed, the forms shall be thoroughly cleaned.
- B. **Form Oil.** The form surfaces shall be treated with a non-staining mineral oil or other lubricant acceptable to the ENGINEER. Any excess lubricant shall be satisfactorily removed before placing the concrete. Where field oiling of forms is required, the CONTRACTOR shall perform the oiling at least 2 weeks in advance of their use. Care shall be exercised to keep oil off the surfaces of steel reinforcement and other metal items to be embedded in concrete.

3.7 FALSEWORK

- A. The CONTRACTOR shall be responsible for the design, engineering, construction, maintenance, and safety of falsework, including staging, walkways, forms, ladders, and similar appurtenances, which shall equal or exceed the applicable requirements of the provisions of the OSHA Safety and Health Standards for Construction, the requirements of the Construction Safety Orders of the California Division of Industrial Safety, and the requirements herein.
- B. Falsework shall be designed and constructed to provide the necessary rigidity and to support the loads. Falsework for the support of a superstructure shall be designed to support the loads that would be imposed if the entire superstructure were placed at one time.

- C. Falsework shall be placed upon a solid footing, safe against undermining, and be protected from softening. When the falsework is supported on timber piles, the maximum calculated pile loading shall not exceed 20-tons. When falsework is supported on any portion of the structure which is already constructed, the load imposed by the falsework shall be spread, distributed, and braced in such a way as to avoid any possibility of damage to the structure.

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SECTION 03 20 00 - REINFORCEMENT STEEL

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide reinforcement steel and appurtenant WORK, complete and in place, in accordance with the Contract Documents.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 - Contractor Submittals.

B. Shop Drawings

1. Shop bending diagrams, placing lists, and drawings of reinforcement steel prior to fabrication. The shop bending diagrams shall show the actual lengths of bars to the nearest inch measured to the intersection of the extensions (tangents for bars of circular cross section) of the outside surface. Include bar placement diagrams that clearly indicate the dimensions of each bar splice.
2. Details of the concrete reinforcement steel and concrete inserts shall be submitted at the earliest possible date after receipt by the CONTRACTOR of the Notice to Proceed. Said details of reinforcement steel for fabrication and erection shall conform to ACI 315 - Details and Detailing of Concrete Reinforcement and the requirements herein.

1.3 QUALITY CONTROL

- A. If requested by the ENGINEER, the CONTRACTOR shall furnish samples from each heat of reinforcement steel in a quantity adequate for testing. Costs of initial tests will be paid by the OWNER. Costs of additional tests if material fails initial tests shall be the CONTRACTOR's responsibility.

PART 2 -- PRODUCTS

2.1 MATERIAL REQUIREMENTS

- A. Materials that may remain or leave residues on or within the concrete shall be certified as compliant with NSF Standard 61- Drinking Water System Components.

2.2 REINFORCEMENT STEEL

- A. **Reinforcement Steel ASTM Standards.** Reinforcement steel for cast-in-place reinforced concrete construction shall conform to the following requirements:

1. Bar and spiral reinforcement shall conform to ASTM A 615 - Deformed and Plain Billet - Steel Bars, for Grade 60 reinforcement unless otherwise indicated.

B. Accessories

1. Accessories shall include necessary chairs, slab bolsters, concrete blocks, tie wires, dips, supports, spacers, and other devices to position reinforcement during concrete placement. Bar supports shall meet the requirements of the CRSI Manual of Standard Practice, including special requirements for supporting epoxy-coated reinforcing bars. Wire bar supports shall be CRSI Class 1 for maximum protection with a 1/8-inch minimum thickness of plastic coating that extends at least 0.5-inch from the concrete surface. Plastic shall be gray in color.
2. Concrete blocks (i.e. dobies) used to support and position reinforcement steel shall have the same or higher compressive strength as required for the concrete in which they are located. Wire ties shall be embedded in concrete block bar supports.

2.3 EPOXY GROUT

- A. Epoxy for grouting reinforcing bars shall be specifically formulated for such application, for the moisture condition, application temperature, and orientation of the hole to be filled. Epoxy grout shall meet the requirements of Section 03 60 00 - Grout.

PART 3 -- EXECUTION

3.1 GENERAL

- A. Reinforcement steel, welded wire fabric, couplers, and other appurtenances shall be fabricated, and placed in accordance with the Building Code and the supplementary requirements herein.

3.2 FABRICATION

A. General

1. Reinforcement steel shall be accurately formed to the dimensions and shapes indicated, and the fabricating details shall be prepared in accordance with ACI 315 and ACI 318 - Building Code Requirements for Reinforced Concrete, except as modified by the Drawings. Bars shall be bent cold. Bars shall be bent per ACI 318.
2. The CONTRACTOR shall fabricate reinforcement bars for structures in accordance with bending diagrams, placing lists, and placing drawings.

- B. **Fabricating Tolerances:** Bars used for concrete reinforcement shall satisfy the following fabricating tolerances:

1. Sheared length: plus and minus 1-inch
2. Depth of truss bars: plus zero, minus 0.5-inch
3. Stirrups, ties, and spirals: plus and minus 0.5-inch
4. Other bends: plus and minus 1-inch

3.3 PLACING

- A. Reinforcement steel shall be accurately positioned as indicated and shall be supported and wired together to prevent displacement, using annealed iron wire ties or suitable clips at intersections. Reinforcement steel shall be supported by concrete, plastic or metal support spacers, or metal hangers that are strong and rigid enough to prevent any displacement of the reinforcement steel. Where concrete is to be placed on the ground, supporting concrete blocks (or dobies) shall be used in sufficient numbers to support the bars without settlement, but in no case shall such support be continuous. Concrete blocks used to support reinforcement steel shall be tied to the steel with wire ties that are embedded in the blocks. For concrete over formwork, the CONTRACTOR shall provide concrete, metal, plastic, or other acceptable bar chairs and spacers.
- B. Limitations on the use of bar support materials shall be as follows.
 - 1. Concrete Dobies
 - a. Permitted at any location except where architectural finish is required.
 - b. Required for slabs on grade and surfaces in contact with or above ozonated process water.
 - 2. Wire Bar Supports: permitted only at slabs over dry areas, interior dry wall surfaces, and exterior wall surfaces.
 - 3. Plastic Bar Supports: permitted at every location except on grade.
- C. Tie wires shall be bent away from the forms in order to provide the required concrete coverage.
- D. Bars additional to those indicated that may be found necessary or desirable by the CONTRACTOR for the purpose of securing reinforcement in position shall be provided by the CONTRACTOR at its own expense.
- E. Unless otherwise indicated, reinforcement placing tolerances shall be within the limits in Section 7.5 of ACI 318 except where in conflict with the Building Code.
- F. Bars may be moved as necessary to avoid interference with other reinforcement steel, conduits, or embedded items. If bars are moved more than one bar diameter or enough to exceed the above tolerances, the resulting arrangement of bars shall be as reviewed and accepted by the ENGINEER.
- G. Accessories supporting reinforcing bars shall be spaced such that there is no deflection of the accessory from the weight of the supported bars. When used to space the reinforcing bars from wall forms, the forms and bars shall be located so that there is no deflection of the accessory when the forms are tightened into position.

3.4 SPACING OF BARS

- A. The clear distance between parallel bars (except in columns and between multiple layers of bars in beams) shall be not less than the nominal diameter of the bars, nor less than 1-1/3 times the maximum size of the coarse aggregate, nor less than one inch.
- B. Where reinforcement in beams or girders is placed in 2 or more layers, the clear distance between layers shall be not less than one inch.
- C. In columns, the clear distance between longitudinal bars shall be not less than 1.5 times the bar diameter, nor less than 1.5 times the maximum size of the coarse aggregate, nor less than 1.5-inches.
- D. The clear distance between bars shall also apply to the distance between a contact splice and adjacent splices or bars.

3.5 SPLICING

A. **General**

- 1. Reinforcement bar splices shall only be used at locations indicated. When it is necessary to splice reinforcement at points other than where indicated, the character of the splice shall be as reviewed and accepted by the ENGINEER.
- 2. Unless otherwise indicated, dowels shall match the size and spacing of the spliced bar.

B. **Splices of Reinforcement**

- 1. The length of lap for reinforcement bars, unless otherwise indicated, shall be in accordance with ACI 318, Section 12.15.1 for a Class B splice.
- 2. Splices in column spiral reinforcement, when necessary, shall be made by welding or by a lap of 1.5 turns.

- C. **Bending or Straightening:** Reinforcement shall not be straightened or rebent in a manner which will injure the material. Bars shall be bent or straight as indicated. Do not use bends different from the bends indicated. Bars shall be bent cold, unless otherwise permitted by the ENGINEER. No bars partially embedded in concrete shall be field bent except as indicated or specifically permitted by the ENGINEER.

3.6 CLEANING AND PROTECTION

- A. Reinforcement steel shall always be protected from conditions conducive to corrosion until concrete is placed around it.
- B. The surfaces of reinforcement steel and other metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed. Where there is delay in depositing concrete, reinforcement shall be re inspected and, if necessary, recleaned.

3.7 EMBEDMENT OF DRILLED REINFORCING STEEL DOWELS

A. Hole Preparation

1. The hole diameter shall be as recommended by the epoxy manufacturer but shall be no larger than 1/4-inch greater than the diameter of the outer surface of the reinforcing bar deformations.
2. The depth of the hole shall be as recommended by the epoxy manufacturer to fully develop the bar but shall not be less than 12 bar diameters, unless indicated otherwise.
3. The hole shall be drilled by methods that do not interfere with the proper bonding of epoxy.
4. Existing reinforcing steel in the vicinity of proposed holes shall be located prior to drilling. The location of holes shall be adjusted to avoid drilling through or nicking any existing reinforcing bars.
5. The hole shall be blown clean with clean, dry compressed air to remove dust and loose particles.

B. Embedment

1. Epoxy shall be injected into the hole through a tube placed to the bottom of the hole. The tube shall be withdrawn as epoxy is placed but kept immersed to prevent formation of air pockets. The hole shall be filled to a depth that ensures excess material will be expelled from the hole during dowel placement.
2. Dowels shall be twisted during insertion into the partially filled hole so as to guarantee full wetting of the bar surface with epoxy. The bar shall be inserted slowly enough to avoid developing air pockets.

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide cast-in-place concrete in accordance with the Contract Documents.
- B. The term "hydraulic structure" used in these Specifications means environmental engineering concrete structures for the containment, treatment, or transmission of water, wastewater, other fluids, or gases.
- C. The following types of concrete are covered in this Section:

- 1. **Structural Concrete**

- a. Regular Mix: Roof, floor slabs, columns, walls, pavements, and other concrete items not indicated otherwise in the Contract Documents.

- 2. **Structural Silica-Fume Concrete**

- a. Silica Fume concrete shall contain a silica fume admixture per the Contract Documents and the silica fume manufacturer's recommendations.

- b. The following shall be constructed of structural Silica-Fume concrete

- 1) Dam A modifications
 - 2) Dam B modifications
 - 3) Intake structure
 - 4) Fish Barrier Apron

- 3. **Sitework Concrete:** Concrete to be used for curbs, gutters, catch basins, sidewalks, fence and guard post embedment, underground duct bank encasement, and other concrete appurtenant to electrical facilities unless otherwise indicated.

- 4. **Lean Concrete:** Concrete to be used for thrust blocks, pipe trench cut-off blocks, and cradles that are indicated on the Drawings as unreinforced. Lean concrete shall be used as protective cover for dowels intended for future connections.

1.2 CONTRACTOR SUBMITTALS

- A. Furnish submittals in accordance with Section 01 33 00 – Contractor Submittals.
- B. **Mix Designs:** Prior to beginning the WORK and within 14 Days of the Notice to Proceed, submit preliminary concrete mix designs which shall show the proportions and

gradations of materials proposed for each class and type of concrete. Mix designs shall be checked through laboratory testing by an independent testing laboratory acceptable to the ENGINEER. Costs related to laboratory testing shall be CONTRACTOR's responsibility as part of the WORK.

- C. **Delivery Tickets:** Where ready-mix concrete is used, the CONTRACTOR shall furnish delivery tickets at the time of delivery of each load of concrete. Each ticket shall show the state-certified equipment used for measuring and the total quantities, by weight, of cement, sand, each class of aggregate, admixtures, the amount of water in the aggregate added at the batching plant, and the amount allowed to be added at the Site for the specific design mix. In addition, each ticket shall state the mix number, total yield in cubic yards, and the time of day, to the nearest minute, corresponding to the times when the batch was dispatched, when it left the plant, when it arrived at the Site, when unloading began, and when unloading was finished.
- D. **Additional Submittals.** Test data relating to the cement, aggregate, and admixtures shall be less than 6 months old. Furnish the following submittals in accordance with ACI 301 – Structural Concrete:
 - 1. Mill tests for cement.
 - 2. Admixture certification. Chloride ion content shall be included.
 - 3. Aggregate gradation test results and certification.
 - 4. Materials and methods for curing.

1.3 CONCRETE CONFERENCE

- A. The ENGINEER will chair a meeting to review the detailed requirements of the CONTRACTOR's proposed concrete design mixes and to determine the procedures for producing proper concrete construction no later than 14 Days after the Notice to Proceed.
- B. Parties involved in the concrete WORK shall attend the conference, including the following at a minimum:
 - 1. CONTRACTOR's representative
 - 2. Testing laboratory representative
 - 3. Concrete Subcontractor
 - 4. Reinforcing steel Subcontractor and detailer
 - 5. Concrete Supplier
 - 6. Admixture manufacturer's representative
- C. The conference shall be held at a time and place proposed by the CONTRACTOR and accepted by the ENGINEER. The conference shall be held at least 5 Days after agreement.

1.4 QUALITY CONTROL

A. General

1. Tests on component materials and for compressive strength and shrinkage of concrete shall be performed as indicated. Tests for determining slump shall be in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete.
2. Testing for aggregate shall include sand equivalence, reactivity, organic impurities, abrasion resistance, and soundness, according to ASTM C 33 – Concrete Aggregates.
3. The cost of laboratory tests on cement, aggregates, and concrete shall be the CONTRACTOR's responsibility. The cost of laboratory tests on field-placed cement, aggregates, and concrete and the cost of Special Inspection required by Code will be the OWNER'S responsibility. However, the CONTRACTOR shall be responsible for the cost of any tests and investigations of WORK that is determined to be Defective WORK. The laboratory shall meet or exceed ASTM C 1077 – Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation.
4. Concrete for testing shall be furnished by the CONTRACTOR, and the CONTRACTOR shall assist the ENGINEER in obtaining samples and disposal and cleanup of excess material.

- B. **Inspections:** Continuous inspection by a special inspector approved by the local building department having jurisdiction and by the ENGINEER will be required to comply with the Statement of Special Inspections to conform with code requirements. Costs of the special inspector shall be paid by the CONTRACTOR. Inspection reports shall be submitted to the ENGINEER.

C. Field Compression Tests

1. Each set of specimens shall be a minimum of 5 cylinders.
2. Compression test specimens for concrete shall be made in accordance with Section 9.2 of ASTM C 31 – Practices for Making and Curing Concrete Test Specimens in the Field. Specimens shall be 6-inches diameter by 12-inches tall cylinders.
3. Frequency of Testing – Building Foundations
 - 1) Sampling frequency and testing for each class of concrete shall be in accordance with ACI 318 section 5.6 as follows:
 - a) Not less than once a day for each class of concrete placed, nor less than:
 - b) Once for each 150 yd³ of each class of concrete placed each day, nor less than:

- c) Once for each 5,000 ft² of slab or wall surface area placed each day.
 - d) If total volume of concrete is such that frequency of testing would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - 2) Frequency of testing may be changed at the discretion of the ENGINEER.
- 4. Frequency of Testing – Hydraulic Structures
 - 1) Sampling frequency and testing for each class of concrete shall be in accordance with ACI 350 section 5.5 as follows:
 - a) Not less than once a day for each class of concrete placed, nor less than:
 - b) Once for each 100 yd³ of each class of concrete placed each day, nor less than:
 - c) Once for each 5,000 ft² of slab or wall surface area placed each day.
 - d) If total volume of concrete is such that frequency of testing would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
 - 2) Frequency of testing may be changed at the discretion of the ENGINEER.
- 5. Compression tests shall be performed in accordance with ASTM C 39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens. One test cylinder will be tested at 7 Days and 2 at 28 Days. The remaining cylinders will be held to verify test results, if needed.

D. Evaluation and Acceptance of Concrete

- 1. Evaluation and acceptance of the compressive strength of concrete will be according to ACI 318 – Building Code Requirements for Reinforced Concrete, Chapter 5 "Concrete Quality," and as indicated.
- 2. A statistical analysis of compression test results will be performed according to ACI 214 – Recommended Practice for Evaluation of Strength Test Methods. The standard deviation of the test results shall not exceed 640 psi, when ordered at equivalent water content as estimated by slump.
- 3. If any concrete fails to meet these requirements, immediate corrective action shall be taken to increase the compressive strength for subsequent batches of the type of concrete affected.
- 4. When the standard deviation of the test results exceeds 640 psi, the average strength for which the mix is designed shall be increased by an amount necessary to satisfy the statistical requirement that the probability of any test being more than

500 psi below or the average of any 3 consecutive tests being below the required compressive strength is 1 in 100. The required average strength shall be calculated by Criterion No. 3 of ACI 214 using the actual standard deviation.

5. Concrete that fails to meet the ACI requirements and these Specifications is subject to removal and replacement.
- E. **Aggregate Testing:** Aggregate testing shall be performed within 12 months of the start of construction and every 12 months during construction to determine continued compliance.
- F. **Construction Tolerances:** The CONTRACTOR shall set and maintain concrete forms and perform finishing operations to ensure that the completed WORK is within tolerances. Surface defects and irregularities are defined as finishes and are different from tolerances. Tolerance is the permissible variation from lines, grades, or dimensions indicated on the Drawings. Where tolerances are not stated in the Specifications, permissible deviations will be in accordance with ACI 117 – Standard Tolerance for Concrete Construction and Materials.
- G. **Floor Slab Hardener**
 1. Job Mockup: In a location designated by the ENGINEER, the CONTRACTOR shall place a 100 square foot floor mockup using the materials and procedures proposed for the WORK. Materials and procedures may be revised as necessary to obtain an acceptable surface, but the same materials and procedures shall be used in the WORK.
 2. Field Service: The CONTRACTOR shall obtain onsite proper usage advice from the surface hardener manufacturer while the job mockup is being placed and during initial placement of the WORK. Notify the surface hardener manufacturer at least 3 Days prior to initial use of the product.
 3. Installer Qualifications: Installer shall have a minimum of 3 years' experience and shall be specialized in application of dry shake surface hardeners.

PART 2 -- PRODUCTS

2.1 CONCRETE MATERIALS

A. General

1. Materials shall be classified as acceptable for potable water use according to NSF Standard 61.
2. Ready-mix concrete shall conform to the requirements of ASTM C 94 – Ready Mixed Concrete.
3. Cement for concrete that will contact potable water shall not be obtained from kilns that burn metal rich hazardous waste fuel.

4. Materials shall be delivered, stored, and handled so as to prevent damage by water or breakage. Cement reclaimed from cleaning bags or leaking containers shall not be used. Cement shall be used in the sequence of receipt of shipments.
- B. Storage of materials shall comply with ACI 301, as applicable.
- C. **Materials.** Materials for concrete shall comply with ACI 301 and shall conform to the following requirements:
1. **Cement.** Cement shall be standard brand Portland cement conforming to ASTM C 150 –Portland Cement, for Type I/II or Type V. A minimum of 85 percent of cement by weight shall pass a 325 screen. A single brand of cement shall be used throughout the WORK, and prior to its use, the brand shall be accepted by the ENGINEER. The cement shall be suitably protected from exposure to moisture until used. Cement that has become lumpy shall not be used. Sacked cement shall be stored in such a manner so as to permit access for inspection and sampling. Certified mill test reports, including fineness, for each shipment of cement to be used shall be submitted to the ENGINEER, if requested, regarding compliance with the Specifications.
 2. **Water.** Water for mixing and curing shall be potable, clean, and free from objectionable quantities of silty organic matter, alkali, salts, and other impurities. The water shall be considered potable, for the purposes of this Section only, if it meets the requirements of the local governmental agencies. Agricultural water with high total dissolved solids (greater than 1000 mg/l TDS) shall not be used.
 3. **Aggregates.** Aggregates shall be obtained from pits acceptable to the ENGINEER, shall be non-reactive, and shall conform to ASTM C 33 – Concrete Aggregates. Maximum size of coarse aggregate shall be as indicated. Substituting lightweight sand for fine aggregate will not be permitted.
 - a. Coarse aggregates shall consist of clean, hard, durable gravel, crushed gravel, crushed rock, or a combination thereof. The coarse aggregates shall be prepared and handled in 2 or more size groups for combined aggregates with a maximum size greater than 3/4-inch. When the aggregates are proportioned for each batch of concrete, the 2 size groups shall be combined.
 - b. Fine aggregates shall be natural sand or a combination of natural and manufactured sand that is hard and durable. When tested in accordance with ASTM D 2419 – Test Methods for Sand Equivalent Value of Soils and Fine Aggregate, the sand equivalency shall not be less than 75 percent for an average of 3 samples, nor less than 70 percent for an individual test. Gradation of fine aggregate shall conform to ASTM C 33 when tested in accordance with ASTM C 136 for the fineness modulus of the sand used, including the optional grading in Section 6.2. The fineness modulus of sand used shall not be over 3.1.
 - c. Combined aggregates shall be well graded from coarse to fine sizes and shall be uniformly graded between screen sizes to produce concrete that has optimum workability and consolidation

characteristics. Where a trial batch is required for a mix design, the final combined aggregate gradations will be established during the trial batch process.

d. When tested in accordance with ASTM C 33, the ratio of silica released to reduction in alkalinity shall not exceed 1.0.

e. When tested in accordance with ASTM C 33, the fine aggregate shall produce a color in the supernatant liquid no darker than the reference standard color solution.

f. When tested in accordance with ASTM C 33, the coarse aggregate shall show a loss not exceeding 42 percent after 500 revolutions or 10.5 percent after 100 revolutions.

g. When tested in accordance with ASTM C 33, the loss resulting after 5 cycles of the soundness test shall not exceed 10 percent for fine aggregate and 12 percent for coarse aggregate when using sodium sulfate.

4. **Flyash.** If used, flyash shall be Class F and meet ASTM C618.

5. **Admixtures.** Admixtures shall be compatible and be furnished by a single manufacturer capable of providing qualified field service representation. Admixtures shall be used in accordance with manufacturer's recommendations. If the use of an admixture is producing an inferior end result, the CONTRACTOR shall discontinue use of the admixture. Admixtures shall not contain thiocyanates nor more than 0.05 percent chloride ion and shall be non-toxic after 30 days.

a. **Air-entraining agents:** Agents shall meet the requirements of ASTM C 260 – Air Entraining Admixtures for Concrete shall be used. Concrete floors to receive a dry-shake floor hardener shall have an air content not to exceed 3 percent. The OWNER reserves the right, at any time, to sample and test the air-entraining agent. The air-entraining agent shall be added to the batch in a portion of the mixing water. The solution shall be batched by means of a mechanical batcher capable of accurate measurement. Air content shall be tested at the point of placement. Air-entraining admixture shall be approved by the ENGINEER prior to use.

b. **Set controlling and water reducing admixtures:** Admixtures may be added at the CONTRACTOR's option, subject to the ENGINEER's approval, to control the set, effect water reduction, and increase workability. The cost of adding an admixture shall be the CONTRACTOR's responsibility. Concrete containing an admixture shall be first placed at a location determined by the ENGINEER. Admixtures shall conform to ASTM C 494 – Chemical Admixtures for Concrete. The required quantity of cement shall be used in the mix regardless of whether or not an admixture is used.

1) Concrete shall not contain more than one water reducing admixture.

- 2) Set controlling admixture may be either with or without water-reducing properties. Admixture shall be appropriate for the air temperature at time of placement. Set controlling admixture shall be approved by the ENGINEER prior to use.
 - 3) Normal range water reducer shall conform to ASTM C 494, Type A. The quantity of admixture used, and the method of mixing shall be in accordance with the manufacturer's instructions and recommendations. Normal range water reducing admixtures shall be approved by the ENGINEER prior to use.
 - 4) High range water reducer shall conform to ASTM C 494, Type F or G. High range water reducer shall be added to the concrete after all other ingredients have been mixed and initial slump has been verified. No more than 14 ounces of water reducer per sack of cement shall be used. Water reducer shall be considered as part of the mixing water when calculating the water/cement ratio. High range water reducing admixtures shall be approved by the ENGINEER prior to use.
 - 5) If the high range water reducer is added to the concrete at the Site, it may be used in conjunction with the same water reducer added at the batch plant. Concrete shall have a slump of 3-inches plus or minus 1/2-inch prior to adding the high range water reducing admixture at the Site. The high range water reducing admixture shall be accurately measured and pressure injected into the mixer as a single dose by an experienced technician. A standby system shall be provided and tested prior to each day's operation of the primary system.
 - 6) Concrete shall be mixed at mixing speed for a minimum of 70 mixer revolutions or 5 minutes after the addition of the high range water reducer, unless recommended otherwise by the manufacturer.
6. **Lithium Additives:** Lithium additives shall not be used in concrete mix design for water bearing structures.
 7. **Silica Fume:** Silica fume shall conform to ASTM C 1240. Silica fume shall be approved by the ENGINEER prior to use. Blended cements with interground silica fume will not be allowed:
 - a. Water content of liquid slurry silica fume admixtures shall be considered as part of the mixing water when calculating the water/cement ratio.
 - b. Silica fume shall be added at the batch plant as recommended by the manufacturer. Regardless of the type of mixing equipment, mix times shall be increased by 40 percent over the minimum mix time required to achieve mix uniformity as defined by ASTM C 94. For truck-mixed and central-mixed concrete, maximum allowable batch size shall be 80 percent of the maximum as called out by ASTM C 94.
 8. **Anti-washout Admixture for Underwater Concrete:** Anti-Washout Admixture shall be in accordance with US Army Corps of Engineers CRD-C 61. Contractor

shall use **MasterMatrix UW 450 anti-washout admixture** by **BASF** or approved equal.

a. Anti-washout Admixture shall be added at the batch plant or at the job site after all other concrete ingredients have been batched and thoroughly mixed as recommended by the manufacturer.

b. Anti-washout Admixtures shall be added with a water reducing admixture as recommended by the manufacturer.

D. **Alkali-Silica Reactivity (ASR) of Aggregates.** All aggregates used in the concrete mix designs shall generally be considered non-reactive (innocuous) aggregate according to the requirements of ASTM C1260 or ASTM 1567 and tested according to the requirements listed below.

1. Fine and coarse aggregates to be used in all concrete shall be evaluated individually and tested for alkali-aggregate reactivity, according to ASTM C1260. The average expansion of the mortar bars for the fine aggregate test according to ASTM C1260 shall not exceed 0.10% at 16-days of immersion in a 1N NaOH solution. Likewise, the average expansion of the mortar bars for the coarse aggregate test according to ASTM C1260 shall not exceed 0.10% at 16-days of immersion in a 1N NaOH solution.

2. If either of the aggregates do not pass the ASTM C1260 test requirements as described above, CONTRACTOR shall provide information to the CONTRACTOR that the proposed fine and coarse aggregate is the best (i.e. least reactive) locally available material within 50-100 miles of the project site. In addition, the CONTRACTOR shall provide additional testing of the proposed aggregates (fine and coarse) along with approved mitigating additives (i.e. fly ash, class N pozzolan, GGBF slag, silica fume or other approved additives) to the concrete mix design, according to the requirements of ASTM C1567 and the following requirements:

a. The concrete mix design parameters used in the ASTM C1567 expansion test shall be within the allowable ranges of mix design parameters as specified under Part 2.5.D of this Section. After 16-days of immersion in a 1N NaOH solution, the average expansion of the three mortar bars shall not exceed 0.10% as measured according to ASTM C1567 standards and protocol.

b. ASR test on both the fine and coarse aggregate and concrete mix additives (i.e. flyash, pozzolan, or other approved additives), sample bar preparation, testing and all analytical methods shall meet the ASTM C1567 testing procedural requirements.

c. Alkali content of the cement in the proposed concrete mix design shall not be greater than the alkali content of the cement used in the test samples.

d. Results of the ASR test show that expansion of the concrete sample is less than 0.10% at 16-days after the start of the expansion test procedure.

e. Test results shall be reported to the CONTRACTOR and Design Engineer at 7-days, 11-days, and 16-days.

- f. The Concrete Supplier is still actively mining and using aggregate from the same representative portion of the aggregate pit from which the aggregate samples were taken for testing.
- 3. In lieu of the ASR testing above the aggregate may be tested in accordance with the requirements of ASTM C1293.
 - a. The concrete mix design parameters used in the ASTM C1293 expansion test shall be within the allowable ranges of mix design parameters as specified under Part 2.5.D of this Section.
 - b. Alkali content of the cement in the proposed concrete mix design shall not be greater than the alkali content of the cement used in the test samples.
 - c. Results of the test, in accordance with ASTM C33, shall indicate less than 0.04% expansion at 1-year for cement aggregate combinations to demonstrate aggregates to be non-reactive.
 - d. Results of the test, in accordance with ASTM C33, shall indicate less than 0.04% expansion at 2-years for cement aggregate combinations with pozzolan or slag to demonstrate aggregates to be non-reactive

2.2 CURING MATERIALS

- A. Curing compounds shall be resin-based and compliant with local VOC requirements.
 - 1. Regular curing compounds shall be white pigmented and conform to ASTM C 309 - Liquid Membrane-Forming Compounds for Curing Concrete, Type 2, Class B. Sodium silicate compounds shall not be allowed. Concrete curing compound shall be approved by the ENGINEER prior to use.
 - 2. When curing compound must be removed for finishes or grouting, compounds shall be a dissipating type meeting ASTM C 309, type 1 or 2, Class B. Concrete curing compound shall be approved by the ENGINEER prior to use.
- B. Polyethylene sheet for use as concrete curing blanket shall be white and shall have a nominal thickness of 6-mils. The loss of moisture when determined in accordance with ASTM C 156 – Test Method for Water Retention by Concrete Curing Materials, shall not exceed 0.055 grams per square centimeter of surface.
- C. Polyethylene-coated waterproof paper sheeting for use as concrete curing blanket shall consist of white polyethylene sheeting free of visible defects, uniform in appearance, have a nominal thickness of 2-mils, and be permanently bonded to waterproof paper conforming to the requirements of Federal Specification UU-B-790A – Building Paper, Vegetable Fiber (Kraft, Waterproofed, Water Repellant and Fire Resistant). The loss of moisture, when determined in accordance with ASTM C 156, shall not exceed 0.055 gram per square centimeter of surface.
- D. Polyethylene-coated burlap for use as concrete curing blanket shall be 4-mils thick with white opaque polyethylene film impregnated or extruded into one side of the burlap. Burlap shall weigh not less than 9 ounces per square yard. The loss of moisture, when

determined in accordance with ASTM C 156, shall not exceed 0.055 grams per square centimeter of surface.

- E. Curing mats for use in Curing Method 6 below shall be heavy shag rugs or carpets or cotton mats quilted at 4-inches on center. Curing mats shall weigh a minimum of 12 ounces per square yard when dry.
- F. Evaporation retardant shall be a material such as **MasterKure ER 50** by **BASF**, **Eucobar** by **Euclid Chemical Company**, **L&M E-CON** by **Laticrete**, or equal.

2.3 NON-WATERSTOP JOINT MATERIALS

- A. Materials for non-waterstop joints in concrete shall conform to the following requirements:
 - 1. Preformed joint filler shall be a non-extruding neoprene sponge or polyurethane type conforming to Section 03 32 00 - Joints in Concrete.
 - 2. Elastomeric joint sealer shall conform to Section 07 92 00 – Joint Sealants.
 - 3. Mastic joint sealer shall be a material that does not contain evaporating solvents; that will tenaciously adhere to concrete surfaces; that will remain permanently resilient and pliable; that will not be affected by continuous presence of water and will not in any way contaminate potable water; and that will effectively seal the joints against moisture infiltration even when the joints are subject to movement from expansion and contraction. The sealer shall be composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance containing no volatile oils or lubricants and shall be capable of meeting the test requirements set forth below, if testing is required by the ENGINEER.

2.4 FLOOR HARDENER (SURFACE APPLIED)

- A. Surface hardener shall be light reflective non-oxidizing metallic aggregate dry shake material that is premeasured, premixed, and packaged at the factory. Surface hardener shall be applied per the manufacturer's recommendations.
- B. Curing compound shall meet the moisture retention requirements of ASTM C 309 and the manufacturer recommendations.
- C. **Monomolecular Film:** Evaporation retarder shall be used to aid in maintaining concrete moisture during the early placement stages of plastic concrete. Evaporation retarder shall be as recommended by the surface hardener manufacturer.
- D. Floor hardener shall be approved by the ENGINEER prior to use.

2.5 MISCELLANEOUS MATERIALS

- A. **Damproofing Agents.** Damproofing agent shall be an asbestos-free, fibered asphalt emulsion intended for cold application to green concrete, both above and below grade. Damproofing shall meet the requirements of ASTM D 1227 – Emulsified Asphalt Used

as a Protective Coating for Roofing, Type II, Class I. Dampproofing shall be approved by the ENGINEER prior to use.

B. **Bonding Agents.** Bonding agents shall be epoxy adhesives conforming to the following:

1. For bonding freshly mixed, plastic concrete to hardened concrete, **Sikadur 32 Hi-Mod Epoxy Adhesive** by **Sika Corporation**, **MasterEmaco ADH 326** by **BASF**, **Sure Bond J58** by **Dayton Superior**, or equal.
2. For bonding hardened concrete or masonry to steel, **Sikadur 31 Hi-Mod Gel** by **Sika Corporation**, **MasterEmaco ADH 327** by **BASF**, or equal.

C. **Vapor Retarder**

1. Vapor retarder shall be 30-mils thick, Class A, 3 ply, nylon or polyester cord-reinforced high-density polyethylene sheet laminated to a non-woven geotextile fabric, in accordance with ASTM E 1745 - Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill Under Concrete Slabs.
2. Granular Material Above Vapor Retarder: Crushed stone, gravel, or sand with the following size distribution and meeting the deleterious substance limits of ASTM C 33 for fine aggregates.

Sieve Size	Percentage Passing
3/8-inch	100
4.75 mm	85-100
No. 100	10 – 30

3. Seams in vapor retarder sheet shall be sealed with tape, adhesive, or other material as recommended by sheet manufacturer for the areas to be sealed and sheet material.

D. **Colorant.** Colorant for duct bank concrete shall be an integral red oxide coloring pigment used in the proportion of 8 pounds per cubic yard of concrete.

2.6 CONCRETE DESIGN REQUIREMENTS

- A. **General:** Concrete shall be composed of cement, admixtures, aggregates, and water of the qualities indicated. In general, the mix shall be designed to produce a concrete capable of being deposited so as to obtain maximum density and minimum shrinkage, and where deposited in forms, to have good consolidation properties and maximum smoothness of surface. The aggregate gradations shall be formulated to provide fresh concrete that will not promote rock pockets around reinforcing steel or embedded items. The proportions shall be changed whenever necessary or desirable to meet the required results. Changes shall be subject to review by the ENGINEER.

- B. **Fine Aggregate Composition:** In mix designs for structural concrete, the percentage of fine aggregate in total aggregate by weight shall be as indicated in the following table.

FINE AGGREGATE	
Fineness Modulus	Maximum Percent
2.7 or less	41
2.7 to 2.8	42
2.8 to 2.9	43
2.9 to 3.1	44

1. For other concrete, the maximum percentage of fine aggregate of total aggregate by weight shall not exceed 50.
- C. Structural silica fume concrete shall contain 10 percent silica fume by weight of cement.
- D. Duct bank concrete shall contain an integral red-oxide coloring pigment. Concrete shall be dyed red throughout. Surface treatment to color duct banks will not be acceptable.
- E. **Water/Cement Ratio W/C:** The water/cement ratio indicated is for saturated-surface dry condition of aggregate. Every Day, throughout the day, the batch water added shall be adjusted for the total free water in the aggregates.
1. Total free moisture of aggregates shall be determined by:
 - a. Starting with the total moisture content of all aggregate, calculated by ASTM C 566 -Test Method for Total Moisture Content of Aggregate by Drying
 - b. Subtracting the moisture absorbed by the coarse aggregate, calculated by ASTM C 127 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate
 - c. Subtracting the moisture absorbed by the fine aggregate, calculated by ASTM C 128 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregate

F. Concrete Property Tables

Structural Concrete	
Type of WORK	Regular Mix (roof, floor slabs, walls, pavements, and other concrete items not categorized elsewhere)
Min 28 Day Compressive Strength, psi	4500
Max Aggregate Size, in	1
Cement Content, lbs /cubic yard,	564 to 600
Max Allowable Fly Ash Content (FA); lbs/cubic yard	Up to 120 (i.e. up to 15% max of cement content)
Max W/C Ratio by weight	0.42
Total Air Content, percent	4.5 to 7.5
Slump, in	3-in +/- 1-in with high range water reducer 7-in +/- 2-in

Other Concrete			
Type of WORK	Structural Silica Fume Concrete (concrete structures indicated to be S-F concrete)	Sitework Concrete (curbs, gutters, sidewalks, catch basins, fence embedment's, encasements, and ductbanks)	Lean Concrete (thrust blocks, pipe trench cut-off blocks, and cradles)
Min 28 Day Compressive Strength, psi	6000	3000	2000
Max Aggregate Size, in	1	1	1
Cement Content per cubic yard, lb.	564 to 600	470 min	376 min
Max W/C Ratio by weight	0.38	0.45	0.60
Total Air Content, percent	4.5 to 7.5	4 to 7	4.5 to 7.5
Slump, in	3-in +/- 1-in with high range water reducer 7-in +/- 2-in	3-in +/- 1-in ductbanks and encasements 5-in +/- 1-in	3-in +/- 1-in

NOTE: The CONTRACTOR is cautioned that the limiting parameters above are not a mix design. Admixtures may be required to achieve workability required by the CONTRACTOR's construction methods and aggregates. The CONTRACTOR is responsible for providing concrete with the required workability and strength.

- G. **Adjustments to Mix Design:** The CONTRACTOR may elect to decrease the water/cement ratio to achieve the strength and shrinkage requirements and/or add water reducers, as required to achieve workability. The mixes shall be changed whenever such change is necessary or desirable to secure the required strength, density, workability, and surface finish, and the CONTRACTOR shall be entitled to no additional compensation because of such changes. Any changes to the accepted concrete mix design shall be submitted to the ENGINEER for review and shall be tested again in accordance with these Specifications.

2.7 CONSISTENCY

- A. The quantity of water in a batch of concrete shall be just sufficient, with a normal mixing period, to produce a concrete that can be worked properly into place without segregation and which can be compacted by vibratory methods to give the desired density, impermeability, and smoothness of surface. The quantity of water shall be changed as

necessary, with variations in the nature or moisture content of the aggregates, to maintain uniform production of a desired consistency. The consistency of the concrete in successive batches shall be determined by slump tests in accordance with ASTM C 143 – Test Method for Slump of Hydraulic Cement Concrete. The slumps shall be as indicated with the concrete properties.

2.8 TRIAL BATCH AND LABORATORY TESTS

- A. The CONTRACTOR shall only use a mix design for construction that has first met the trial batch testing requirements or approved historical concrete testing results as specified below.

1. **Trial Batch Concrete Testing.** Before placing any concrete, a testing laboratory selected by the ENGINEER shall prepare a trial batch of each class of structural concrete, based on the preliminary concrete mixes submitted by the CONTRACTOR. During the trial batch the aggregate proportions may be adjusted by the testing laboratory using the two coarse aggregate size ranges to obtain the required properties. If one size range produces an acceptable mix, a second size range need not be used. Such adjustments will be considered refinements to the mix design and will not be the basis for extra compensation to the CONTRACTOR. Concrete shall conform to the requirements of this Section whether the aggregate proportions are from the CONTRACTOR's preliminary mix design or whether the proportions have been adjusted during the trial batch process. The trial batch shall be prepared using the aggregates, cement, and admixture proposed for the project. The trial batch materials shall be of a quantity such that the testing laboratory can obtain 3 drying shrinkage, and 6 compression test specimens from each batch.
2. **Historical Concrete Testing.** For shrinkage testing as well as ASR expansion testing requirements, the CONTRACTOR may propose the use of historical test results on these tests provided that all of the following conditions are met:
 - a. The test results are no more than 6-months old from the project Notice-to-Proceed date.
 - b. The mix design used in the proposed historical tests has the same characteristics, as described below, as the mix design proposed for use on the project:
 - 1) The type and quantity of cement used in the historical tested mix, is the same as that of the proposed mix design.
 - 2) The quantity and source location of the coarse and fine aggregate used in the historical tested mix is the same as that of the proposed mix design. In addition, the aggregate used in the historical tests must be screened to the same gradations as that proposed for the project mix design.
 - 3) The type and quantity of cementations substitutes (fly ash or slag or other approved substitute) used in the historical tested mix, is the same as that of the proposed mix design.
 - 4) The water to cement ratio of the historical tested mix is within +/- 5% of the proposed water to cement ratio.

- 5) The air content of the historical tested mix is within 1% of the proposed air content (for example: for a proposed air content of 6% in the proposed mix design, the historical air content must be in the range of 5 to 7%.)
- 6) The same additives, including water reducing additives, that were used in the historical batch test results are being proposed for the new concrete mix design, and the proportions of those additives used in the historical mix design are within +/- 5% of that of the proposed project mix design.

B. Compressive Strength Testing. The determination of compressive strength will be made by testing 6-inch diameter by 12-inch high cylinders; made, cured, and tested in accordance with ASTM C 192 - Practice for Making and Curing Concrete Test Specimens in the Laboratory and ASTM C 39. Three compression test cylinders will be tested at 7 Days and 3 at 28 Days. The average compressive strength for the 3 cylinders tested at 28 Days for any given trial batch shall not be less than 125 percent of the indicated compressive strength.

C. Sieve Analyses. A sieve analysis of the combined aggregate for each trial batch shall be performed according to the requirements of ASTM C 136 – Method for Sieve Analysis of Fine and Coarse Aggregates. Values shall be given for percent passing each sieve.

2.9 SHRINKAGE LIMITATION FOR STRUCTURAL CONCRETE

- A. The maximum concrete shrinkage for specimens cast as measured at 21 Day drying age or at 28 Day drying age shall be 0.042 percent or 0.050 percent, respectively. Standard deviation will not be considered. The CONTRACTOR shall only use a mix design for construction that has first met the shrinkage requirements. Shrinkage limitations apply only to structural concrete.
- B. The maximum concrete shrinkage for specimens cast in the field shall not exceed the maximum shrinkage requirement by more than 25 percent.
- C. If the required shrinkage limitation is not met during construction, the CONTRACTOR shall take any or all of the following actions to reestablish compliance. These actions may include changing the source of aggregates, cement and/or admixtures; reducing water/cement ratio; washing of coarse and/or fine aggregate to reduce fines; increasing the number of construction joints; modifying the curing requirements; or other actions to minimize shrinkage or the effects of shrinkage.

2.10 MEASUREMENT OF CEMENT AND AGGREGATE

- A. The amount of cement and of each separate size of aggregate entering into each batch of concrete shall be determined by direct weighing equipment furnished by the CONTRACTOR and acceptable to the ENGINEER. Weighing tolerances for the materials shall be a maximum of that given below.

Material	Percent of Total Weight
Cement	1
Aggregates	3

Admixtures	3
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2.11 MEASUREMENT OF WATER

- A. The quantity of water entering the mixer shall be measured by a suitable water meter or other measuring device of a type acceptable to the ENGINEER and capable of measuring the water in variable amounts within a tolerance of one percent. The water feed control mechanism shall be capable of being locked in position so as to deliver constantly any required amount of water to each batch of concrete. A positive quick-acting valve shall be used for a cut-off in the water line to the mixer. The operating mechanism shall prevent leakage when the valves are closed.

2.12 READY-MIXED CONCRETE

- A. At the CONTRACTOR'S option, ready-mixed concrete may be used if it meets the requirements as to materials, batching, mixing, transporting, and placing indicated herein and is in accordance with ASTM C 94, including the following supplementary requirements.
- B. Ready-mixed concrete shall be delivered to the WORK, and discharge shall be completed within one hour after the addition of the cement to the aggregates or before the drum has been revolved 250 revolutions, whichever occurs first.
- C. Truck mixers shall be equipped with electrically actuated counters by which the number of revolutions of the drum or blades may be readily verified. The counter shall be the resettable, recording type and shall be mounted in the driver's cab. The counters shall be actuated at the time of starting mixers at mixing speeds.
- D. Each batch of concrete shall be mixed in a truck mixer for not less than 70 revolutions of the drum or blades at the rate of rotation designated by the manufacturer of equipment. Additional mixing, if any, shall be at the speed designated by the manufacturer of the equipment as agitating speed. Materials including mixing water shall be in the mixer drum before actuating the revolution counter for determining the number of revolutions of mixing.
- E. Truck mixers and their operation shall be such that the concrete throughout the mixed batch as discharged is within acceptable limits of uniformity with respect to consistency, mix, and grading. If slump tests taken at approximately the 1/4 and 3/4 points of the load during discharge give slumps differing by more than one-inch when the required slump is 3-inches or less, or if they differ by more than 2-inches when the required slump is more than 3-inches, the mixer shall not be used on the WORK unless the causative condition is corrected and satisfactory performance is verified by additional slump tests. Mechanical details of the mixer, such as water measuring and discharge apparatus, condition of the blades, speed of rotation, general mechanical condition of the unit, and clearance of the drum, shall be checked before a further attempt to use the unit will be permitted.
- F. Each batch of ready-mixed concrete delivered to the Site shall be accompanied by a delivery ticket that is furnished to the ENGINEER in accordance with the Paragraph above entitled "Delivery Tickets."

- G. The use of non-agitating equipment for transporting ready-mixed concrete will not be permitted. Combination truck and trailer equipment for transporting ready-mixed concrete will not be permitted. The quality and quantity of materials used in ready-mixed concrete and in batch aggregates shall be subject to continuous inspection at the batching plant by the ENGINEER.

PART 3 -- EXECUTION

3.1 PROPORTIONING AND MIXING

- A. **Proportioning:** Proportioning of the mix shall conform to ACI 301.
- B. **Mixing:** Mixing shall conform to ACI 301.
- C. **Slump:** Slumps shall be as indicated.
- D. **Retempering:** Retempering of concrete or mortar that has partially hardened shall not be permitted.

3.2 PREPARATION OF SURFACES FOR CONCRETING

- A. **General:** Earth surfaces shall be thoroughly wetted by sprinkling prior to the placing of any concrete, and these surfaces shall be kept moist by frequent sprinkling up to the time of placing concrete thereon. The surface shall be free from standing water, mud, and debris at the time of placing concrete.
- B. **Vapor Retarder Sheet**
 - 1. Sheet shall be installed under on-grade building floor slabs of occupiable (non-hydraulic) structures and at other locations indicated.
 - 2. Sand base shall be at least 2-inches thick within the foundation line after moistening and compaction by mechanical means. Sand surface shall be flat and level within a tolerance of plus zero inches to minus 3/4-inch.
 - 3. Place, protect, and repair defects in sheet according to ASTM E 1643 – Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs, and the manufacturer's written instructions. Seams shall be lapped and sealed in accordance with ASTM E 1643.
 - 4. Granular material above the sheet shall be moistened and compacted to 2-inches thickness within the same flatness criteria as the sand base.
- C. **Joints in Concrete:** Construction joints are defined as concrete surfaces upon which or against which concrete is to be placed but placement of concrete has been stopped or interrupted and the ENGINEER has determined that the new concrete cannot be incorporated integrally with the concrete previously placed. The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by

hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed.

- D. After the surfaces have been prepared, each approximately horizontal construction joint shall be covered with a 6-inch lift of a pea gravel mix. The mix shall be placed and spread uniformly. Wall concrete shall follow immediately and shall be placed upon the fresh pea gravel mix.
- E. **Placing Interruptions:** When placing of concrete is to be interrupted long enough for the concrete to take a set, the working face shall be given a shape by the use of forms or other means that will secure proper union with subsequent WORK; provided that construction joints shall be made only where acceptable to the ENGINEER.
- F. **Embedded Items:** No concrete shall be placed until formwork, installation of parts to be embedded, reinforcement steel, and preparation of surfaces involved in the placing have been completed and accepted by the ENGINEER at least 4 hours before placement of concrete. Surfaces of forms and embedded items that have become encrusted with dried grout from previous usage shall be cleaned before the surrounding or adjacent concrete is placed.
- G. Inserts or other embedded items shall conform to the requirements herein.
- H. Reinforcement, anchor bolts, sleeves, inserts, and similar items shall be set and secured in the forms at locations indicated on the Drawings or shown by Shop Drawings and shall be acceptable to the ENGINEER before any concrete is placed. Accuracy of placement is the responsibility of the CONTRACTOR.
- I. **Anchor Rod Tolerances:** Anchor rods shall be placed to the tolerances in the AISC Code of Standard Practice.
- J. **Casting New Concrete Against Old:** Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless determined otherwise by the ENGINEER. This provision shall not apply to joints where waterstop is provided.
- K. No concrete shall be placed in any structure until water entering the space to be filled with concrete has been properly cut off or has been diverted by pipes or other means, and carried out of the forms, clear of the WORK. No concrete shall be deposited underwater nor shall the CONTRACTOR allow still water to rise on any concrete until the concrete has attained its initial set. Water shall not be permitted to flow over the surface of any concrete in such manner and at such velocity as will injure the surface finish of the concrete. Pumping or other necessary dewatering operations for removing ground water, if required, shall be subject to review by the ENGINEER.
- L. **Corrosion Protection:** Pipe, conduit, dowels, and other ferrous items required to be embedded in concrete construction shall be so positioned and supported prior to placement of concrete that there will be a minimum of 2-inches clearance between said items and any part of the concrete reinforcement. Securing such items in position by wiring or welding them to the reinforcement will not be permitted.

- M. Openings for pipes, inserts for pipe hangers and brackets, and anchors shall, where practicable, be provided during the placing of concrete.
- N. Anchor bolts shall be accurately set and shall be maintained in position by templates while embedded in concrete.
- O. **Cleaning:** The surfaces of metalwork to be in contact with concrete shall be thoroughly cleaned of dirt, grease, loose scale and rust, grout, mortar, and other foreign substances immediately before the concrete is placed.

3.3 HANDLING, TRANSPORTING, AND PLACING

- A. **General:** Placing of concrete shall conform to the applicable portions of ACI 301 and the requirements of this Section. No aluminum materials shall be used in conveying any concrete.
- B. **Non-Conforming WORK or Materials:** Concrete which during or before placing is found not to conform to the requirements indicated herein shall be rejected and immediately removed from the WORK. Concrete that is not placed in accordance with these requirements or which is of inferior quality shall be removed and replaced.
- C. **Unauthorized Placement:** No concrete shall be placed except in the presence of a duly authorized representative of the ENGINEER. The CONTRACTOR shall notify the ENGINEER in writing at least 24 hours in advance of placement of any concrete.
- D. **Placement in Wall and Column Forms:** Concrete shall not be dropped through reinforcement steel or into any deep form, nor shall concrete be placed in any form in such a manner as to leave accumulation of mortar on the form surfaces above the placed concrete. In such cases, means such as hoppers and, if necessary, vertical ducts of canvas, rubber, or metal shall be used for placing concrete in the forms in a manner that it may reach the place of final deposit without separation. In no case shall the free fall of concrete below the ends of ducts, chutes, or buggies exceed 4-feet in walls and 8-feet in columns. Concrete shall be uniformly distributed during the process of depositing and in no case after depositing shall any portion be displaced in the forms more than 6-feet in horizontal direction. Concrete in wall forms shall be deposited in uniform horizontal layers not deeper than 2-feet; and care shall be taken to avoid inclined layers or inclined construction joints except where such are required for sloping members. Each layer shall be placed while the previous layer is still soft. The rate of placing concrete in wall forms shall not exceed 5-feet of vertical rise per hour. Sufficient illumination shall be provided in the interior of forms so that the concrete at the places of deposit is visible from the deck or runway.
- E. **Conveyor Belts and Chutes:** Ends of chutes, hopper gates, and other points of concrete discharge throughout the CONTRACTOR's conveying, hoisting, and placing system shall be designed and arranged so that concrete passing from them will not fall separated into whatever receptacle immediately receives it. Conveyor belts, if used, shall be of a type acceptable to the ENGINEER. Chutes longer than 50-feet will not be permitted. Minimum slopes of chutes shall be such that concrete of the indicated consistency will readily flow in them. If a conveyor belt is used, it shall be wiped clean by a device operated in such a manner that none of the mortar adhering to the belt will be wasted. Conveyor belts and chutes shall be covered.

F. **Placement in Slabs:** Concrete placement in sloping slabs shall proceed uniformly from the bottom of the slab to the top for the full width of the placement. As the WORK progresses, the concrete shall be vibrated and carefully worked around the slab reinforcement, and the surface of the slab shall be screeded in an up-slope direction.

G. **Temperature of Concrete:** The temperature of concrete when it is being placed shall be not more than 90 degrees F nor less than 50 degrees F. For sections less than 12-inches thick the temperature of concrete when placed shall be not less than 55 degrees.

1. If required by ENGINEER, CONTRACTOR shall submit detailed procedures for production, transportation, placement, protection, curing, and temperature monitoring of concrete during hot or cold weather. The submittal shall include procedures to be implemented upon abrupt changes in weather conditions or equipment failures.

2. CONTRACTOR shall not be entitled to additional compensation for satisfying the hot weather placement or the cold weather placement requirements below.

H. **Hot Weather Placement**

1. If the temperature of the concrete is 85 degrees F or greater, the time between introducing the cement into the aggregates and discharge shall not exceed 45 minutes.

2. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90 degrees F, CONTRACTOR shall employ effective means such as precooling of aggregates and using ice as mixing water or placing at night as necessary to maintain the temperature of the concrete below 90 degrees F as it is placed.

3. During the curing period, the maximum temperature decrease measured at the surface of the concrete shall not exceed 50 degrees F in 24 hours nor 5 degrees F in one hour.

I. **Cold Weather Placement**

1. Placement of concrete shall conform to ACI 306.1 - Cold Weather Concreting, and the following.

2. Remove snow, ice, and frost from the surfaces, including reinforcement, against which concrete is to be placed. Before beginning concrete placement, thaw the subgrade to a minimum depth of 6-inches. Reinforcement and embedded items shall be warmed to above 32 degrees F prior to concrete placement.

3. Maintain the concrete temperature above 50 degrees F for at least 72 hours after placement.

4. Concrete ingredients shall not be heated more than necessary to prevent the temperature of the mixed concrete, as placed, from falling below the minimum temperature criterion.

J. **Underwater Placement**

1. Concrete deposited in water shall be designed for underwater placement with anti-washout admixtures. No concrete shall be placed in or under water unless otherwise permitted in writing by the ENGINEER.
2. To prevent segregation, concrete shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom dump bucket, or other approved method, and shall not be disturbed after being deposited.
3. Concrete shall not be placed in running water. The forms for underwater concrete shall be constructed to provide static water within the forms. The concrete shall be placed continuously until the required depth is reached, keeping the surface of the concrete as nearly level as possible during placing.
4. If a tremie is used, the placing shall comply with the following requirements:
 - a. A tremie shall consist of a watertight tube having a diameter of not less than 10 inches with a hopper at the top. The tube shall be equipped with a device that will prevent water from entering the tube while charging the tube with concrete. The tremie shall be supported so as to permit free movement of the discharge end over the entire top surface of the work and to permit rapid lowering, when necessary to retard or stop the flow of the concrete. The tremie shall be filled by a method that will prevent washing of the concrete. The discharge end shall be completely submerged in concrete at all times and the tremie tube shall contain sufficient concrete to prevent water entry. When concrete is dumped into the hopper, the flow of concrete shall be induced by slightly raising the discharge end always keeping it in the deposited concrete.

3.4 PUMPING OF CONCRETE

- A. **General:** If the pumped concrete does not produce satisfactory end results, the CONTRACTOR shall discontinue the pumping operation and proceed with the placing of concrete using conventional methods.
- B. **Pumping Equipment:** The pumping equipment shall have 2 cylinders and be designed to operate with one cylinder in case the other one is not functioning. In lieu of this requirement, the CONTRACTOR may have a standby pump on the Site during pumping.
- C. The minimum diameter of the hose conduits shall be in accordance with ACI 304.2R – Placing Concrete by Pumping Methods.
- D. Pumping equipment and hose conduits that are not functioning properly shall be replaced.
- E. Aluminum conduits for conveying the concrete shall not be permitted.
- F. **Field Control:** Concrete samples for slump, air content, and test cylinders will be taken at the placement end of the hose.

3.5 ORDER OF PLACING CONCRETE

- A. The order of placing concrete in the WORK shall be acceptable to the ENGINEER. To minimize the effects of shrinkage, the concrete shall be placed in units as bounded by construction joints at the indicated locations. The placing of units shall be done by placing alternate units in a manner such that each unit placed shall have cured at least 5 Days for hydraulic structures and 2 Days for all other structures before the contiguous unit or units are placed, except that the corner sections of vertical walls shall not be placed until the 2 adjacent wall panels have cured at least 10 Days for hydraulic structures and 4 Days for all other structures.
- B. The surface of the concrete shall be level whenever a run of concrete is stopped. For a level, straight joint on the exposed surface of walls, a wood strip at least 3/4-inch thick shall be tacked to the forms on these surfaces. The concrete shall be carried about 1/2-inch above the underside of the strip. About one hour after the concrete is placed, the strip shall be removed and any irregularities in the edge formed by the strip shall be leveled with a trowel and laitance shall be removed.

3.6 TAMPING AND VIBRATING

- A. As concrete is placed in the forms or in excavations, it shall be thoroughly settled and compacted throughout the entire depth of the layer which is being consolidated into a dense, homogeneous mass, filling all corners and angles, thoroughly embedding the reinforcement, eliminating rock pockets, and bringing only a slight excess of water to the exposed surface of concrete. Vibrators shall be Group 3 per ACI 309 – Consolidation of Concrete, high speed power vibrators (8000 to 12,000 rpm) of an immersion type in sufficient number and with at least one standby unit as required. Group 2 vibrators may be used only at specific locations when accepted by the ENGINEER.
- B. Care shall be used in placing concrete around waterstops. The concrete shall be carefully worked by rodding and vibrating to make sure that air and rock pockets have been eliminated. Where flat-strip type waterstops are placed horizontally, the concrete shall be worked under the waterstops by hand, making sure that air and rock pockets have been eliminated. Concrete surrounding the waterstops shall be given additional vibration over and above that used for adjacent concrete placement to assure complete embedment of the waterstops in the concrete.
- C. Concrete in walls shall be internally vibrated and at the same time rammed, stirred, or worked with suitable appliances, tamping bars, shovels, or forked tools until it completely fills the forms or excavations and closes snugly against each surface. Subsequent layers of concrete shall not be placed until the layers previously placed have been worked thoroughly. Vibrators shall be provided in sufficient numbers, with standby units as required, to accomplish the required results within 15 minutes after concrete of the prescribed consistency is placed in the forms. The vibrating head shall not contact the surfaces of the forms. Care shall be taken not to vibrate concrete excessively or to work it in any manner that causes segregation of its constituents.

3.7 FINISHING CONCRETE SURFACES

- A. **General:** Surfaces shall be free from fins, bulges, ridges, offsets, honeycombing, or roughness of any kind, and shall present a finished, smooth, continuous hard surface. Allowable deviations from plumb or level and from the alignment, profiles, and

dimensions indicated are defined as tolerances and are indicated above. These tolerances are to be distinguished from irregularities in finish as described herein. Aluminum finishing tools shall not be used.

B. **Unformed Surfaces:** After proper and adequate vibration and tamping, unformed top surfaces of slabs, floors, walls, and curbs shall be brought to a uniform surface with suitable tools. Immediately after the concrete has been screeded, it shall be treated with a liquid evaporation retardant. The retardant shall be used again after each operation as necessary to prevent drying shrinkage cracks. Fog nozzles are required for slabs containing silica fume admixtures. The classes of finish for unformed concrete surfaces are defined as follows:

1. Finish U1 - Sufficient leveling and screeding to produce an even, uniform surface with surface irregularities not to exceed 3/8-inch. No further special finish is required.
2. Finish U2 - After sufficient stiffening of the screeded concrete, surfaces shall be float finished with wood or metal floats or with a finishing machine using float blades. Excessive floating of surfaces while the concrete is plastic and dusting of dry cement and sand on the concrete surface to absorb excess moisture will not be permitted. Floating shall be the minimum necessary to produce a surface that is free from screed marks and is uniform in texture. Surface irregularities shall not exceed 1/4-inch. Joints and edges shall be tooled where indicated or as determined by the ENGINEER.
3. Finish U3 - After the Finish U2 surface has hardened sufficiently to prevent excess of fine material from being drawn to the surface, steel troweling shall be performed with firm pressure such as will flatten the sandy texture of the floated surface and produce a dense, uniform surface free from blemishes, ripples, and trowel marks. The finish shall be smooth and free of irregularities.
4. Finish U4 - Trowel the Finish U3 surface to remove local depressions or high points. In addition, the surface shall be given a light broom finish with brooming perpendicular to drainage unless otherwise indicated. The resulting surface shall be rough enough to provide a nonskid finish.
5. Unformed surfaces shall be finished according to the following schedule:

UNFORMED SURFACE FINISH SCHEDULE	
Area	Finish
Grade slabs and foundations to be covered with concrete or fill material	U1
Floors to be covered with grouted tile or topping grout	U2
Water bearing slabs with slopes 10 percent and less	U3
Water bearing slabs with slopes greater than 10	U4

percent	
Slabs not water bearing	U4
Slabs to be covered with built-up roofing	U2
Interior slabs and floors to receive architectural finish	U3
Top surface of walls	U3

C. Floor Hardener (Surface Applied)

1. The following additional requirements apply to the substrate concrete in areas indicated to be under floor hardener:
 - a. Slump shall be no greater than 4-inches when peak ambient temperatures are expected to exceed 65 degrees F and no greater than 3-inches when temperatures will not exceed 65 degrees F.
 - b. Air content of the concrete shall not exceed 3 percent.
 - c. No calcium chloride or set accelerating admixture containing calcium chloride shall be used.
 - d. Do not use admixtures that increase bleeding.
 - e. Do not use fly ash.
2. The CONTRACTOR shall finish areas indicated to receive hardener in conformance with the manufacturer's recommendations and the following. After leveling the concrete surface and as soon as the concrete will support an operator and machine without disturbing the level or working up excessive fines, the CONTRACTOR shall float the surface of the slab with a mechanical float fitted with detachable shoes. Then apply 1/2 to 2/3 of the total amount of dry shake surface hardener uniformly to the surface. A mechanical spreader is recommended. Float the surface once the shake has absorbed sufficient moisture, as indicated by darkening of the shake. Immediately apply the remainder of the shake and allow it to absorb moisture. Do not apply shake when bleed water is present.
3. Perform a third floating if time and setting characteristics of the concrete will allow, but do not add water to the surface.
4. As the surface stiffens further and loses sheen, trowel with blades set relatively flat, using hand or mechanical methods. Remove marks and pinholes in a final raised trowel operation.
5. Cure the finished surface using the fill-forming curing compound recommended by the manufacturer at a coverage rate which will provide moisture retention in excess of the requirements of ASTM C 309. Maintain ambient temperatures above 50 degrees F during the curing period.

6. Keep floors covered and prohibit traffic and loads for 10 days minimum after completion.

3.8 CURING AND DAMPPROOFING

- A. **General:** Concrete shall be cured for not less than 7 Days after placing, in accordance with the methods indicated below for the different parts of the WORK.

Surface to be Cured or Dampproofed	Method
Unstripped forms	1
Wall sections with forms removed	6
Construction joints between footings and walls, and between floor slab and columns	2
Encasement and duct bank concrete and thrust blocks	3
Concrete surfaces not specifically indicated in this Paragraph	4
Floor slabs on grade in hydraulic structures	5
Slabs not on grade	6

- B. **Method 1:** Wooden forms shall be wetted immediately after concrete has been placed and shall be kept wet with water until removal. If steel forms are used the exposed concrete surfaces shall be kept continuously wet until the forms are removed. If forms are removed within 7 Days of placing the concrete, curing shall be continued in accordance with Method 6 below.
- C. **Method 2:** The surface shall be covered with burlap mats which shall be kept wet with water for the duration of the curing period, until the concrete in the walls has been placed. No curing compound shall be applied to surfaces cured under Method 2.
- D. **Method 3:** The surface shall be covered with moist earth not less than 4 hours nor more than 24 hours after the concrete is placed. Earthwork operations that may damage the concrete shall not begin until at least 7 Days after placement of concrete.
- E. **Method 4:** The surface shall be sprayed with a liquid curing compound.
1. Compound shall be applied in accordance with the manufacturer's printed instructions at a maximum coverage rate of 200 square feet per gallon and in such a manner as to cover the surface with a uniform film that will seal thoroughly.
 2. Where the curing compound method is used, care shall be exercised to avoid damage to the seal during the 7 Day curing period. If the seal is damaged or broken before expiration of the curing period, the break shall be repaired immediately by the application of additional curing compound over the damaged portion.

3. Wherever curing compound has been applied by mistake to surfaces against which concrete subsequently is to be placed and to which it is to adhere, compound shall be entirely removed by wet sandblasting just prior to the placing of new concrete.
4. Curing compound shall be applied as soon as the concrete has hardened enough to prevent marring on unformed surfaces and within 2 hours after removal of forms. Repairs to formed surfaces shall be made within the 2-hour period; provided, however, that any such repairs which cannot be made within the said 2-hour period shall be delayed until after the curing compound has been applied. When repairs are to be made to an area on which curing compound has been applied, the area involved shall first be wet sandblasted to remove the curing compound.
5. At locations where concrete is placed adjacent to a panel which has been coated with curing compound, the panel shall have curing compound reapplied to an area within 6-feet of the joint and to any other location where the curing membrane has been disturbed.
6. Prior to final acceptance of the WORK, visible traces of curing compound shall be removed in such a manner that does not damage the surface finish.

F. Method 5:

1. Until the concrete surface is covered with curing compound, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed. The concrete shall be given a coat of curing compound in accordance with Method 4 above. Not less than one hour nor more than 4 hours after the curing compound has been applied, the surface shall be wetted with water delivered through a fog nozzle, and concrete-curing blankets shall be placed on the slabs. The curing blankets shall be polyethylene sheet, polyethylene-coated waterproof paper sheeting, or polyethylene-coated burlap. The blankets shall be laid with the edges butted together and with the joints between strips sealed with 2-inch wide strips of sealing tape or with edges lapped not less than 3-inches and fastened together with a waterproof cement to form a continuous watertight joint.
2. The curing blankets shall be left in place during the 7 Day curing period and shall not be removed until after concrete for adjacent WORK has been placed. If the curing blankets become torn or otherwise ineffective, the CONTRACTOR shall replace damaged sections. During the first 3 Days of the curing period, no traffic of any nature and no depositing, temporary or otherwise, of any materials shall be permitted on the curing blankets. During the remainder of the curing period, foot traffic and temporary depositing of materials that impose light pressure will be permitted only on top of plywood sheets 5/8-inch minimum thickness, laid over the curing blanket. The CONTRACTOR shall add water under the curing blanket as often as necessary to maintain concrete surfaces damp.

G. Method 6: This method applies to both walls and slabs.

1. The concrete shall be kept continuously wet by the application of water for a minimum period of at least 7 Days beginning immediately after the concrete has reached final set or forms have been removed.

2. Until the concrete surface is covered with the curing medium, the entire surface shall be kept damp by applying water using nozzles that atomize the flow so that the surface is not marred or washed.
 3. Heavy curing mats shall be used as a curing medium to retain the moisture during the curing period. The curing medium shall be weighted or otherwise held substantially in contact with the concrete surface to prevent dislodging by wind or any other causes. Edges shall be continuously held in place.
 4. The curing blankets and concrete shall be kept continuously wet by the use of sprinklers or other means both during and after normal working hours.
 5. Immediately after the application of water has terminated at the end of the curing period, the curing medium shall be removed, the entire concrete surface shall be wetted, and curing compound shall be immediately applied to the entire surface in accordance with Method 4 above.
 6. The CONTRACTOR shall dispose of excess water from the curing operation to avoid damage to the WORK.
- H. **Method 7:** This method applies to concrete containing silica fume for walls and slabs and shall be used in addition to the curing methods 1 through 6 and shall be concluded within one hour of concrete placement.
1. In addition to the requirements of Method 1 for unstripped forms, Method 6 for walls after the forms are removed, and Method 4 for slabs, wall surfaces after the forms are removed and slab surfaces shall be coated with 2 coats of a white pigmented curing compound as indicated in Method 4 above. A second coat of white pigmented curing compound shall be applied to the concrete surface at 7 Days after the application of the initial coats. In addition, a prewetted burlap shall be placed over the flatwork surface and kept continuously wet for a minimum of 7 Days or until the time necessary to attain 70 percent of the required compressive strength in accordance with ACI 308 Section 3.1.3.
- I. **Dampproofing.** The exterior surfaces of roof slabs to be buried and walls to be backfilled shall be dampproofed as follows
1. Immediately after completion of curing the surface shall be sprayed with a dampproofing agent consisting of an asphalt emulsion. Application shall be in 2 coats. The first coat shall be diluted to one-half strength by the addition of water and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon of dilute solution. The second coat shall consist of an application of the undiluted material and shall be sprayed on so as to provide a maximum coverage rate of 100 square feet per gallon.
 2. As soon as the material has taken an initial set, the entire area thus coated shall be coated with whitewash. Any formula for mixing the whitewash may be used if it produces a uniformly coated white surface and remains until placing of the backfill. If the whitewash fails to remain on the surface until the backfill is placed, the CONTRACTOR shall apply additional whitewash.

3.9 PROTECTION

- A. The CONTRACTOR shall protect concrete against injury until final acceptance.
- B. Fresh concrete shall be protected from damage due to rain, hail, sleet, or snow. The CONTRACTOR shall provide such protection while the concrete is still plastic and whenever precipitation is imminent or occurring.

3.10 CURING IN COLD WEATHER

- A. Water curing of concrete may be reduced to 6 Days during periods when the mean daily temperature in the vicinity of the Site is less than 40 degrees F; provided that during the prescribed period of water curing, when temperatures are such that concrete surfaces may freeze, water curing is temporarily discontinued.
- B. Concrete cured by an application of curing compound will require no additional protection from freezing if the protection at 50 degrees F for 72 hours is obtained by means of approved insulation in contact with the forms or concrete surfaces; otherwise the concrete shall be protected against freezing temperatures for 72 hours immediately following 72 hours protection at 50 degrees F. Concrete cured by water shall be protected against freezing temperatures for 72 hours immediately following the 72 hours of protection at 50 degrees F.
- C. Discontinuance of protection against freezing temperatures shall be such that the drop-in temperature of any portion of the concrete will be gradual and will not exceed 40 degrees F in 24 hours. In the spring, when the mean daily temperature rises above 40 degrees F for more than 3 successive Days, the required 72-hour protection at a temperature not lower than 50 degrees F may be discontinued for as long as the mean daily temperature remains above 40 degrees F; provided, that the concrete shall be protected against freezing temperatures for not less than 48 hours after placement.
- D. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. Use of unvented heaters will be permitted only when unformed surfaces of concrete adjacent to the heaters are protected for the first 24 hours from an excessive carbon dioxide atmosphere by application of curing compound; provided, that the use of curing compound for such surfaces is otherwise permitted.

3.11 TREATMENT OF SURFACE DEFECTS

- A. As soon as forms are removed, exposed surfaces shall be carefully examined, and any irregularities shall be immediately rubbed or ground in a satisfactory manner in order to secure a smooth, uniform, and continuous surface. Plastering or coating of surfaces to be smoothed will not be permitted. No repairs shall be made until after inspection by the ENGINEER. In no case will extensive patching of honeycombed concrete be permitted. Concrete containing minor voids, holes, honeycombing, or similar depression defects shall be repaired as indicated below. Concrete containing extensive voids, holes, honeycombing, or similar depression defects shall be completely removed and replaced. Repairs and replacements shall be performed promptly.
- B. Defective surfaces to be repaired shall be cut back from trueline a minimum depth of 1/2-inch over the entire area. Feathered edges will not be permitted. Where chipping or cutting tools are not required in order to deepen the area properly, the surface shall be

prepared for bonding by the removal of laitance and soft material, plus not less than 1/32-inch depth of the surface film from hard portions by means of an efficient sandblast. After cutting and sandblasting, the surface shall be wetted sufficiently in advance of shooting with shotcrete or with cement mortar so that while the repair material is being applied, the surfaces underneath will remain moist but not so wet as to overcome the suction upon which a good bond depends. The material used for repair shall consist of a mixture of one sack of cement to 3 cubic feet of sand. For exposed walls, the cement shall contain such a proportion of white portland cement as is required to make the color of the patch match the color of the surrounding concrete.

- C. Holes left by tie-rod cones shall be reamed with suitable toothed reamers so as to leave the surfaces of the holes clean and rough. Holes then shall be repaired in an approved manner with dry-packed cement grout. Holes left by form-tying devices having a rectangular cross section and other imperfections having a depth greater than their least surface dimension shall not be reamed but shall be repaired in an approved manner with dry-packed cement grout.
- D. Repairs shall be built up and shaped in such a manner that the completed WORK will conform to the requirements of this Section, as applicable, using approved methods which will not disturb the bond, cause sagging, or cause horizontal fractures. Surfaces of repairs shall receive the same kind and amount of curing treatment as required for the concrete in the repaired section.

3.12 CARE AND REPAIR OF CONCRETE

- A. The CONTRACTOR shall protect concrete against injury or damage from excessive heat, lack of moisture, overstress, or any other cause until final acceptance. Particular care shall be taken to prevent the drying of concrete and to avoid roughening or otherwise damaging the surface. Any concrete found to be damaged, or which may have been originally defective, or which becomes defective at any time prior to the final acceptance of the completed WORK, or which departs from the established line or grade, or which, for any other reason, does not conform to the requirements of the Contract Documents, shall be satisfactorily repaired or removed and replaced with acceptable concrete.

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SECTION 03 32 00 - JOINTS IN CONCRETE

PART 1 -- GENERAL

1.1 SUMMARY

- A. The CONTRACTOR shall provide joints in concrete, complete and in place, in accordance with the Contract Documents.
- B. Joints in concrete structures shall be the types defined below and will be permitted only where indicated, unless specifically accepted by the ENGINEER.

1.2 TYPES OF JOINTS

A. Construction Joints (CJ)

- 1. These joints are typically identified / abbreviated as "CJ" on the Contract Drawings.
- 2. The purpose of a construction joint is to bond concrete from an earlier pour to that of a later pour, and if in a water-bearing member, prevent water seepage at the joint location.
- 3. When fresh concrete is placed against a hardened concrete surface, the joint between the pours shall be defined as a construction joint.
- 4. Reinforcement typical to the slab exists across the joint.
- 5. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop of the type and shape indicated.

B. Contraction Joints (CRJ)

- 1. These joints are typically identified / abbreviated as "CRJ" on the Contract Drawings.
- 2. The purpose of a contraction joint is to de-bond concrete from an earlier pour to that of a later pour, and if in a water-bearing member, prevent water seepage at the joint location.
- 3. Contraction joints are similar to construction joints except that bonding is discouraged between the pours (chamfers, bond breaker),
- 4. Reinforcement typical to the slab does not pass through the joint. Sleeve-like dowels may exist across the joint, as indicated.
- 5. Waterstop shall be provided where indicated.

C. Expansion Joints (EJ)

- 1. These joints are typically identified / abbreviated as "EJ" on the Contract Drawings.

2. The purpose of an expansion joint is to allow concrete to expand freely as required, and if in a water-bearing member, prevent water seepage at the joint location.
3. In order to allow the concrete to expand freely, a space shall be provided between the pours. The space shall be obtained by placing a joint filler (premolded expansion joint material) against the earlier pour to act as a form for the later pour.
4. Reinforcement typical to the slab does not pass through the joint. Sleeve-like dowels may exist across the joint, as indicated.
5. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop of the shape indicated.

D. Crack Control Joints (CCJ)

1. These joints are typically identified / abbreviated as "CCJ" on the Contract Drawings.
2. The function of the control joint is to provide a weaker plane in the concrete where shrinkage cracks would likely occur, and if in a water-bearing member, prevent water seepage at the joint location. There are different alternatives that can achieve this goal. The alternative(s) selected for the WORK is (are) provided in the Contract Documents.
3. Reinforcement typical to the slab exists across the joint.
4. Unless otherwise indicated, joints in water-bearing members shall be provided with a waterstop of the type and shape indicated.

1.3 CONTRACTOR SUBMITTALS

- A.** Furnish submittals in accordance with the requirements of Section 01 33 00 – Contractor Submittals.

B. Shop Drawings

1. Furnish placement drawings showing the location and types of joints for each structure.

C. Manufacturer's Information and Certificates

1. Furnish manufacturer's information demonstrating compliance of the following with the indicated requirements:
 - a. **Waterstops.** Prior to use of the waterstop material in the field, a sample of a prefabricated (shop made fitting) mitered cross and a tee constructed of each size or shape of material to be used shall be submitted. Samples shall be prefabricated (shop made fitting) so that the material and workmanship represent the fittings to be provided.
 - b. preformed joint filler

- c. backing rod
 - d. bearing pad
 - e. slip dowels
2. Furnish written certification from the manufacturer, as an integral part of the shipping form, that the material shipped to the Site meets or exceeds the indicated physical property requirements.
 3. Supplier certificates will not be accepted.

D. Test Reports – Joint Sealant

1. Furnish certified test reports from the joint sealant manufacturer on the actual batch of material supplied, demonstrating compliance with the indicated requirements.
2. Furnish the test reports before using the joint sealant on the Project.

E. Samples

1. Prior to production of the material required under this Section, submit qualification samples of waterstops which accurately represent the material being provided.
2. Such samples shall be extruded or molded sections of each size or shape to be installed.
3. The balance of the material to be used shall not be produced until after the ENGINEER has reviewed the qualification samples.

F. Welding Certification

1. Furnish copies of the waterstop welding certification by manufacturer or authorized agent of the manufacturer.
2. Every person who is to be involved with waterstop installation shall be required to have individual certification on file with the ENGINEER, stating that the named individual is certified and trained to install waterstop in accordance with the manufacturer's recommendations and specifications.

1.4 QUALITY CONTROL

A. Waterstops

1. Inspections.

- a. Waterstop field joints shall be subject to inspection, and no such WORK shall be scheduled or started without having made prior arrangements with the ENGINEER for the required inspections.
- b. Provide not less than 24 hours notice for the scheduling of such inspections.

- c. Field joints in waterstops shall be subject to inspection for misalignment, bubbles, inadequate bond, porosity, cracks, offsets, and other defects that would reduce the potential resistance of the material to water pressure at any point.

2. Sample Testing.

- a. Field samples of prefabricated fittings (crosses, tees, and the like) may be selected at random by the ENGINEER for testing by a laboratory at the OWNER's expense.
- b. When tested, the tensile strength across the joints shall be at least 1,120 psi for PVC waterstops.

3. Defects. The following waterstop defects represent a partial list of defects which shall be grounds for rejection:

- a. Offsets at joints greater than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- b. Exterior cracking at the joint due to incomplete bond, which is deeper than 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- c. Any combination of offset or exterior cracking that will result in a net reduction in the cross-section of the waterstop in excess of 1/16 inch or 15 percent of material thickness at any point, whichever is less.
- d. Misalignment of the joint which results in misalignment of the waterstop in excess of 1/2 inch in 10 feet.
- e. Porosity in the welded joint as evidenced by visual inspection.
- f. Bubbles or inadequate bonding which can be detected with a penknife test. (If, while prodding the entire joint with the point of a penknife, the knife breaks through the outer portion of the weld into a bubble, the joint shall be considered defective.)
- g. Visible signs of separation when the cooled splice is bent by hand at any sharp angle.
- h. Evidence of burned material.

B. Joint Sealant

1. Test specimens.

- a. The CONTRACTOR shall prepare adhesion and cohesion test specimens at intervals of 5 Days while joint sealants are being installed.
- b. The joint sealant material shall show no signs of adhesive or cohesive failure when tested in accordance with the following procedure in laboratory and field tests:

- 1) Joint sealant specimen shall be prepared between 2 concrete blocks (1-inch by 2-inch by 3-inch).
- 2) Spacing between the blocks shall be one inch.
- 3) Coated spacers (2-inch by 1-1/2-inch by 1/2-inch) shall be used to set and hold joint sealant cross-sections of 1/2-inch by 2-inch with a width of one inch.
- 4) The joint sealant shall be cast and cured in accordance with the manufacturer's recommendations, except that the curing period shall be not less than 24 hours.
- 5) Following the curing period, the gap between the blocks shall be widened to 1-1/2 inches, and spacers shall be used to maintain this gap for 24 hours prior to inspection for failure.

1.5 CORRECTION OF DEFECTS

- A. **Waterstops.** If inspections find waterstops to be defective, these joints shall be replaced with material that passes inspection, and faulty material shall be removed from the Site and destroyed.
- B. **Joint Sealant.** The CONTRACTOR shall furnish a 5-year written warranty of the entire joint sealant installation against faulty and/or incompatible materials and workmanship, together with a statement that the CONTRACTOR agrees to repair or replace, to the satisfaction of the OWNER, any defective areas which become evident within the 5-year period.

PART 2 -- PRODUCTS

2.1 GENERAL

- A. Joint materials shall be listed as compliant with NSF Standard 61.

2.2 WATERSTOPS

A. **PVC Waterstops**

1. Waterstops shall be extruded from an elastomeric polyvinyl chloride compound containing the plasticizers, resins, stabilizers, and other materials necessary to meet the indicated requirements of this Section.
2. No reclaimed or scrap material shall be used.
3. The CONTRACTOR shall obtain from the waterstop manufacturer and shall furnish to the ENGINEER for review, current test reports and a written certification of the manufacturer that the material to be shipped to the Site meets the physical requirements as outlined in the U.S. Army Corps of Engineers Specification CRD-C572-PVC Waterstops, and those indicated.

4. When tested in accordance with the indicated test standards, the waterstop material shall meet or exceed the following requirements:

Physical Property, Sheet Material	Value	ASTM Std
Tensile Strength-min, psi	2,000	D 638, Type IV
Ultimate Elongation-min, percent	350	D 638, Type IV
Low Temp Brittleness, max degrees F	-35	D 746
Stiffness in Flexure, min, psi	600	D 747
Accelerated Extraction (CRD-C572)		
Tensile Strength-min, psi	1,500	D 638, Type IV
Ultimate Elongation, min, percent	300	D 638, Type IV
Effect of Alkalis (CRD-C572)		
Change in Weight, percent	plus 0.25/minus 0.10	-----
Change in Durometer, Shore A	plus and minus 5	D 2240
Finish Waterstop		
Tensile Strength-min, psi	1,400	D 638, Type IV
Ultimate Elongation, min percent	280	D 638, Type IV

5. Flat strip and Center-Bulb Waterstops

- Flat strip and center-bulb waterstops shall be manufactured such that at no place shall the thickness of waterstops, including the center bulb type, be less than 3/8 inch.
- The waterstop shall be provided with hog rings installed at 12 inches on centers along the waterstop.
- Shapes shall be as indicated, or as acceptable to the ENGINEER.

6. Retrofit Waterstops

- Retrofit waterstops and batten bars shall be as indicated or as acceptable to the ENGINEER.
- The waterstop shall be supplied as a complete system including waterstop, SS batten bar, SS anchor bolts, and epoxy gel.

B. Preformed Hydrophilic Waterstop

1. Hydrophilic (bentonite-free) waterstops shall be **Sika Hydrotite CJ** manufactured by **Sika Corporation**, **Type NB190** manufactured by **JP Specialties**, or equal.
2. The cross-sectional area of the waterstop shall not be less than 0.5 square inch.
3. Hydrophilic waterstop shall be the type that expands in the presence of water to form a watertight joint seal without damaging the concrete in which it is cast.
4. The waterstop shall be manufactured from butyl rubber with hydrophilic properties.
5. The waterstop shall have a delay coating to inhibit initial expansion due to moisture present in fresh concrete.
6. The minimum expansion ratio of modified chloroprene shall be not less than 2-to-1 volumetric change in distilled water at 70 degrees F (21 degrees C).
7. The bonding agent for hydrophilic waterstop shall be the manufacturer's recommended adhesive for wet, rough concrete.

C. Waterproofing Tape

1. Waterproofing tape waterstops shall be **Sikadur Combiflex SG** manufactured by **Sika Corporation** or approved equal.

D. Other Waterstops

1. When types of waterstops not listed above are indicated, they shall be subjected to the same requirements as those listed in this Section.

2.3 JOINT SEALER FOR NON-WATER-BEARING JOINTS

- A. Joint sealer for non-waterstop joints in concrete shall be a material that is composed of special asphalts or similar materials blended with lubricating and plasticizing agents to form a tough, durable mastic substance that shall:
1. Not contain evaporating solvents, or volatile oils/lubricants;
 2. Strongly adhere to concrete surfaces;
 3. Remain permanently resilient and pliable;
 4. Not be affected by continuous presence of water;
 5. Not in any way contaminate potable water;
 6. Effectively seal the joints against moisture infiltration even when the joints are subjected to movement from expansion and contraction.

2.4 JOINT FILLER

- A. Joint filler for expansion joints in water holding structures shall be neoprene conforming to ASTM D 1056, Type 2C5-E1.
- B. Joint filler material in other locations shall be of the preformed non-extruding type, constructed of cellular neoprene sponge rubber or polyurethane of firm texture.
- C. Non-extruding and resilient-type preformed expansion joint fillers shall conform to the requirements and tests set forth in ASTM D 1752 - Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction, for Type I, except as otherwise indicated.
- D. **Neoprene Sponge.** The sponge shall be neoprene, closed-cell, expanded, conforming to ASTM D 1056 - Flexible Cellular Materials - Sponge or Expanded Rubber, Type 2C5-E1.

2.5 BACKING ROD

- A. The backing rod shall be an extruded closed-cell, polyethylene foam rod.
- B. The rod material shall be compatible with the joint sealant material and shall have a tensile strength of not less than 40 psi and a compression deflection of approximately 25 percent at 8 psi.
- C. The rod shall be 1/8 inch larger in diameter than the joint width except that a one-inch diameter rod shall be used for a 3/4-inch wide joint.

2.6 BEARING PAD

- A. The bearing pad shall be neoprene conforming to ASTM D 2000 - Standard Classification System for Rubber Products in Automotive Applications, BC 420, 40 durometer hardness, unless otherwise indicated.

2.7 SLIP DOWELS

- A. Slip dowels in joints shall be smooth epoxy-coated bars conforming to ASTM A 775 - Epoxy Coated Reinforcing Steel Bars.

2.8 PVC TUBING

- A. PVC tubing in joints shall be SDR 13.5, conforming to ASTM D 2241 - Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

PART 3 -- EXECUTION

3.1 GENERAL - WATERSTOPS

- A. Waterstops shall be embedded in the concrete across joints as indicated.
- B. Waterstops shall be fully continuous for the extent of the joint.

- C. Splices necessary to provide such continuity shall conform to the printed instructions of the waterstop manufacturer.
- D. The CONTRACTOR shall take suitable precautions and provide means to support and protect the waterstops during the progress of the WORK and shall repair or replace any waterstops damaged during progress of the WORK at no additional cost to the OWNER.
- E. Waterstops shall be stored so as to permit free circulation of air around the waterstop material.
- F. When any waterstop is installed in the concrete on one side of a joint while the other portion of the waterstop remains exposed to the atmosphere for more than 2 Days, suitable precautions shall be taken to shade and protect the exposed waterstop from direct rays of the sun during the entire exposure time until the exposed portion of waterstop is embedded in concrete.

3.2 SPLICES IN PVC WATERSTOPS

- A. Splices in PVC waterstops shall be performed by heat sealing the adjacent waterstop sections in accordance with the manufacturer's printed recommendations.
- B. It is essential that:
 - 1. The material shall not be damaged by heat sealing.
 - 2. The splices shall have a tensile strength of not less than 80 percent of the unspliced material.
 - 3. The continuity of the waterstop ribs and of its tubular center axis shall be maintained.
 - 4. No edge welding will be accepted.
- C. Butt joints of the ends of 2 identical waterstop sections may be made while the material is in the forms.
- D. Other Joints
 - 1. Joints with waterstops involving more than 2 ends to be jointed together, and joints that involve an angle cut, alignment change, or the joining of 2 dissimilar waterstop sections, shall be prefabricated prior to placement in the forms, allowing not less than 24-inch long strips of waterstop material beyond the joint.
 - 2. Upon inspection and approval, such prefabricated waterstop joint assemblies shall be installed in the forms and the ends of the 24-inch strips shall be butt-welded to the straight run portions of waterstop in place in the forms.
- E. Where a centerbulb waterstop intersects and is jointed with a non-centerbulb waterstop, care shall be taken to seal the end of the centerbulb, using additional PVC material if needed.

3.3 JOINT CONSTRUCTION

A. **Setting Waterstops**

1. In order to eliminate faulty installation that may result in joint leakage, particular care shall be taken as to the correct positioning of the waterstops during installation.
2. Adequate provisions shall be made to support and anchor the waterstops during the progress of the WORK and to ensure proper embedment in the concrete.
3. The symmetrical halves of the waterstops shall be equally divided between the concrete pours at the joints.
4. The center axis of the waterstops shall be coincident with the joint openings.
5. Thoroughly work the concrete in the vicinity of joints for maximum density and imperviousness.

B. **Waterstop Placement**

1. In placing waterstops in the forms, means shall be provided to prevent them from being folded over by the concrete as it is placed.
2. Waterstops shall be held in place with light wire ties on 12-inch centers, which shall be passed through hog rings at the edge of the waterstop and tied to the curtain of reinforcing steel.
3. Horizontal waterstops, with their flat face in a vertical plane, shall be held in place with continuous supports to which the top edge of the waterstop shall be tacked.
4. In placing concrete around horizontal waterstops with their flat face in a horizontal plane, the concrete shall be worked under the waterstops by hand in order to avoid the formation of air and rock pockets.
5. In placing center-bulb waterstops in expansion joints, the center-bulb shall be centered on the joint filler material.
6. Waterstop in vertical wall joints shall terminate 6 inches from the top of the wall, where such waterstop does not connect with any other waterstop and is not to be connected to a future concrete placement.

C. **Joint Location**

1. Construction joints and other types of joints shall be provided where indicated.
2. If not indicated, construction joints shall be provided at a 25-foot maximum spacing.
3. Where joints are indicated to be spaced greater than 40 feet apart, additional joints shall be provided to maintain the 25-foot maximum spacing.
4. The location of joints, regardless of type, shall be submitted for acceptance by the ENGINEER.

D. Joint Preparation

1. **Construction Joints:** The surfaces of horizontal joints shall be given a compacted, roughened surface for good bonding. Except where the Drawings call for joint surfaces to be coated, the joint surfaces shall be cleaned of laitance, loose or defective concrete, foreign material, and be roughened to a minimum of 1/4-inch amplitude. Such cleaning and roughening shall be accomplished by hydroblasting or sandblasting (exposing aggregate) followed by thorough washing. Pools of water shall be removed from the surface of construction joints before the new concrete is placed. The following is also required:
 - a. Special care shall be used in preparing concrete surfaces at joints where bonding between 2 sections of concrete is required.
 - b. Unless otherwise indicated, such bonding shall be required at every horizontal joint in walls.
2. **Old Concrete:** Where concrete is to be cast against old concrete (defined as any concrete which is greater than 60 Days old), the surface of the old concrete shall be thoroughly cleaned and roughened by hydroblasting or sandblasting to expose aggregate. The joint surface shall be coated with an epoxy bonding agent unless determined otherwise by the OWNER. This provision shall not apply to joints where waterstop is provided.

E. Retrofit Waterstops

1. **Joint Preparation**
 - a. Existing surfaces to receive a retrofit waterstop shall be clean and free from any loose or foreign material.
 - b. The surface shall be given a light sandblast or hydroblast finish to 1/8-inch amplitude prior to the application of epoxy and waterstop.
2. Retrofit waterstops shall be set in a bed of epoxy over a sandblasted surface with stainless steel batten bars and 1/4-inch diameter stainless steel anchors at 6 inches on-center, staggered, and in accordance with the manufacturer's written recommendations.

F. Joint Sealant

1. Crack control joints in water-bearing floor slabs and elsewhere as indicated shall be provided with tapered grooves which shall be filled with a joint sealant, as indicated.
2. The material used to form the tapered grooves shall be left in the grooves until just before the grooves are cleaned and filled with joint sealant.
3. After removing the forms from the grooves, laitance and fins shall be removed, and the grooves shall be sand blasted.

4. The grooves shall be allowed to thoroughly dry, after which they shall be blown out and immediately thereafter, they shall be primed and filled with the construction joint sealant.
5. No joint sealant shall be used without a primer. The primer and sealant shall be placed strictly in accordance with the printed recommendations of the manufacturer, taking special care to properly mix the sealant prior to application.
6. The sides of the sealant groove shall not be coated with bond breaker, curing compound, or any other substance which would interfere with proper bonding of the joint sealant.
7. Care shall be used to completely fill the sealant grooves.
8. The joint sealant shall be installed by a competent waterproofing specialty contractor with a successful record of performance in similar installations.
9. The joint sealant shall achieve final cure at least 7 Days before the structure is filled with water.

10. Mixing

- a. Catalyst-cured, 2-part materials shall be thoroughly, and uniformly mixed, and special care shall be taken to properly mix the sealer before its application.
- b. Before any sealer is placed, the CONTRACTOR shall arrange to have workers performing the WORK carefully instructed on the proper method of mixing and application by a representative of the joint sealant manufacturer.

11. Failure to Cure

- a. Any joint sealant that fails to fully and properly cure after the manufacturer's recommended curing time for the conditions of the WORK shall be completely removed, and the groove shall be thoroughly sandblasted to remove traces of the uncured or partially cured sealant and primer.
- b. The groove shall be re-sealed with the indicated joint sealant.
- c. Costs of such removal, joint treatment, re-sealing, and appurtenant WORK shall be the CONTRACTOR's responsibility as part of the WORK.

G. Hydrophilic Waterstop

1. Where a hydrophilic waterstop is indicated, it shall be installed in accordance with the manufacturer's instructions and recommendations except as may be modified in this Section.
2. When requested by the ENGINEER, the CONTRACTOR shall arrange for the manufacturer to furnish technical assistance in the field.
3. Hydrophilic waterstop shall only be used where complete confinement by concrete is provided.

4. Hydrophilic waterstop shall not be used in expansion or contraction joints nor in the first 6 inches of a non-intersecting joint.
5. **Location**
 - a. The hydrophilic waterstop shall be located as near as possible to the center of the joint, and it shall be continuous around the entire joint.
 - b. The minimum distance from the edge of the waterstop to the face of the member shall be 5 inches.
6. **Placement**
 - a. Where the thickness of the concrete member to be placed on the hydrophilic waterstop is less than 12 inches, the waterstop shall be placed in grooves formed or ground into the concrete.
 - b. The groove shall be at least 3/4-inch-deep and 1-1/4 inches wide.
 - c. When placed in the groove, the minimum distance from the edge of the waterstop to the face of the member shall be 2-1/2 inches.
7. Where a hydrophilic waterstop is used in combination with PVC waterstop, the hydrophilic waterstop shall overlap the PVC waterstop for a minimum of 6 inches and shall be adhered to PVC waterstop by a single component water-swelling sealant as recommended by the manufacturer.
8. The hydrophilic waterstop shall not be installed where the air temperature falls below the manufacturer's recommended range.
9. **Preparation**
 - a. The concrete surface under the hydrophilic waterstop shall be smooth and uniform, and the concrete shall be ground smooth if needed.
 - b. Alternatively, the hydrophilic waterstop shall be bonded to the surface using an epoxy grout that completely fills voids and irregularities beneath the waterstop material.
 - c. Prior to installation, the concrete surface shall be wire brushed to remove any laitance or other materials that may interfere with the bonding of epoxy.
10. **Securing**
 - a. The hydrophilic waterstop shall be secured in place with concrete nails and washers at 12-inch maximum spacing.
 - b. The above requirement shall be in addition to the adhesive recommended by the manufacturer.

- END OF SECTION -

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