TECHNICAL SPECIFICATIONS
NUU'ULI TURBIDITY PLANT PROJECT
American Samoa Power Authority
October 2025

SECTION 31 23 23 – ENGINEERING FILL

PART 1 – GENERAL

1.1 SUMMARY

This section covers requirements for placement and compaction of engineered fill materials for embankments, foundations, slabs, and backfills.

1.2 REFERENCES

ASTM D698 – Standard Proctor Compaction Test
ASTM D1557 – Modified Proctor Compaction Test
ASTM D4318 – Liquid Limit, Plastic Limit, and Plasticity Index
ASTM D422 – Particle Size Analysis
AASHTO T99 / T180 – Moisture-Density Relations
ASTM D6938 – In-Place Density and Moisture by Nuclear Method

1.3 SUBMITTALS

Material source and test reports.
Proctor test curves.
In-place compaction test results.

PART 2 – PRODUCTS

2.1 ENGINEERED FILL MATERIAL

Shall be **granular soil** free from organic matter, roots, debris, clay lumps, or stones larger than 3 inches.
Plasticity Index ≤ 15.
Passing No. 200 sieve ≤ 12%.
Acceptable materials include well-graded sand and gravel meeting **AASHTO A-1-a to A-2-4** classifications.

2.2 UNSUITABLE MATERIALS

Topsoil, peat, organic silt, or clay.
Any material containing frozen lumps or debris.

PART 3 – EXECUTION

3.1 SUBGRADE PREPARATION

Remove topsoil, vegetation, and unsuitable materials.
Scarify subgrade to a minimum of 8 inches, moisture-condition, and compact to **90% of ASTM D1557** maximum dry density.

3.2 PLACEMENT

Place fill in **maximum 8-inch compacted lifts** (loose thickness not to exceed 12 inches).
Spread uniformly and compact each layer before placing the next.

3.3 COMPACTION REQUIREMENTS

Location	Minimum Compaction	Test Method
Structural foundations	95% of ASTM D1557	Field density tests

Location	Minimum Compaction	Test Method
Slab-on-grade and pavement subgrade	95% of ASTM D1557	
General embankment / backfill	90% of ASTM D1557	

3.4 MOISTURE CONTROL

Maintain fill within ±2% of optimum moisture content at time of compaction.

Add or aerate material as required.

3.5 FIELD QUALITY CONTROL

Field density testing per ASTM D6938 at frequency of **one test per 500 sq ft per lift** or as directed by Engineer.

Recompact any area failing to meet density or moisture requirements.

SECTION 31 10 00 – CLEARING AND GRUBBING

PART 1 – GENERAL

1.1 SUMMARY

Work includes clearing, grubbing, removing, and disposing of vegetation, roots, logs, debris, and other objectionable materials within project limits as shown on the drawings or directed by the Engineer.

1.2 REFERENCES

ASTM D2487 – Classification of Soils for Engineering Purposes

ASTM D1557 – Laboratory Compaction Characteristics of Soil (Modified Proctor)

AASHTO M145 – Classification of Soils and Soil-Aggregate Mixtures

AASHTO R-47 – Clearing and Grubbing Guidelines

1.3 SUBMITTALS

Proposed disposal method and site for cleared materials.

Work schedule and equipment list.

PART 2 – PRODUCTS

2.1 MATERIALS

No materials are required for this section except as needed for temporary erosion or dust control. Erosion control measures shall conform to **ASTM D6460** (Standard Test Method for Erosion Control Product Performance).

PART 3 – EXECUTION

3.1 SITE PREPARATION

Locate and protect all existing utilities, structures, and features to remain.

Mark clearing limits as indicated on the drawings.

Do not disturb trees or vegetation designated to remain.

3.2 CLEARING

Remove trees, brush, logs, stumps, roots, vegetation, and other debris from the designated area.

Cut stumps flush with the ground or as directed.

Fell trees to avoid damage to adjacent properties and vegetation to remain.

3.3 GRUBBING

Remove stumps and roots **larger than 2 inches in diameter** to a minimum depth of **18 inches below finished subgrade**.

Excavate and remove buried logs, debris, and organic matter.

Backfill holes with approved soil and compact to **90% of ASTM D1557** maximum dry density.

3.4 DISPOSAL

Dispose of cleared and grubbed material off-site at an approved location, or as directed by the Engineer.

Burning on-site is prohibited unless specifically approved and permitted by the local authority.

Recycle or reuse cleared material where possible (e.g., chipping for mulch, erosion control).

3.5 SCARIFICATION AND GRADING

After grubbing, scarify ground surface to a minimum depth of **6 inches**.

Recompact scarified surface to **90% of ASTM D1557** density.

Ensure positive drainage and smooth transition to adjacent undisturbed ground.

3.6 FIELD QUALITY CONTROL

Inspection by Engineer for completeness of clearing and grubbing before placement of fill or embankment.

No fill material shall be placed until the cleared area is approved.

SECTION 31 25 00 – EROSION AND SEDIMENT CONTROL

PART 1 – GENERAL

1.1 SUMMARY

This section covers materials and procedures for controlling erosion, sedimentation, and stormwater runoff during and after construction until permanent stabilization is achieved.

1.2 REFERENCES

ASTM D6460 – Standard Test Method for Erosion Control Product Performance

ASTM D1557 – Laboratory Compaction Characteristics of Soil (Modified Proctor)

ASTM D5268 – Topsoil for Establishing Vegetation

ASTM D4475 – Determination of Erosion Control Blanket Durability

AASHTO M288 – Geotextile Specification for Highway Applications

U.S. EPA – NPDES Construction General Permit (CGP)

1.3 SUBMITTALS

Erosion and Sediment Control Plan (ESCP) or Stormwater Pollution Prevention Plan (SWPPP).

Product data for geotextiles, silt fences, erosion control blankets, and seeding materials.

Maintenance schedule for erosion control measures.

1.4 ENVIRONMENTAL PROTECTION

Prevent sediment-laden runoff from leaving the construction site.

Protect adjacent properties, waterways, and storm drains from siltation.

Maintain erosion control devices until permanent stabilization is established.

PART 2 – PRODUCTS

2.1 SILT FENCE

Geotextile fabric: nonwoven polypropylene, meeting **AASHTO M288** Class 2.

Support posts: 1.5" nominal diameter wood or steel, spaced at max **8 ft O.C.**

Height: 24–36 inches above ground.

2.2 EROSION CONTROL BLANKETS / MATS

Biodegradable straw, coconut fiber, or jute mat conforming to **ASTM D6460**.

Used on slopes greater than 3H:1V or disturbed areas susceptible to runoff.

2.3 CHECK DAMS

Constructed from stone, sandbags, or wattles.
Stone size: 3–6 inches, minimum crest height 18 inches.

2.4 SEDIMENT BASINS / TRAPS

Earthen or rock structures designed to intercept and settle sediment.
Provide outlet protection per approved drawings.

2.5 SEEDING AND MULCH

Topsoil: per **ASTM D5268**, minimum 4 inches thick.
Seed mixture: native grasses per site conditions.
Mulch: straw or fiber mulch at **2 tons/acre**.

PART 3 – EXECUTION

3.1 INSTALLATION

Install erosion and sediment control measures **prior to any grading or soil disturbance.**
Construct devices in accordance with the approved Erosion and Sediment Control Plan.
Silt fence: trench and anchor 6 inches below grade.
Check dams: spaced to prevent overtopping and reduce channel velocity.
Erosion blankets: secure per manufacturer's instructions with staples at 2-ft spacing.

3.2 MAINTENANCE

Inspect all controls **weekly and after every rainfall > 0.5 inch**.
Remove accumulated sediment when depth reaches 1/3 of device height.
Repair or replace damaged materials immediately.

3.3 FINAL STABILIZATION

Upon completion of grading, seed and mulch all disturbed areas.
Maintain temporary controls until vegetation is established (minimum 70% cover).
Remove all temporary control devices once permanent stabilization is approved by Engineer.

3.4 FIELD QUALITY CONTROL

Inspections by Engineer or Environmental Compliance Officer.
Maintain records of maintenance and rainfall events.

SECTION 32 31 13 – CHAIN LINK FENCES AND GATES

PART 1 – GENERAL

1.1 SUMMARY

Work includes furnishing and installing commercial-grade chain link fences, gates, posts, and related fittings complete and in accordance with drawings and specifications.

1.2 REFERENCES

ASTM A121 – Zinc-Coated (Galvanized) Steel Chain-Link Fence Fabric
ASTM A123 – Zinc Coating (Hot-Dip) on Iron and Steel Products
ASTM A153 – Zinc Coating on Iron and Steel Hardware
ASTM F567 – Installation of Chain-Link Fence
ASTM F668 – Polyvinyl Chloride (PVC) Coated Chain-Link Fence Fabric
ASTM F1043 – Strength and Protective Coatings for Steel Fence Framework
ASTM F1083 – Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized)
AASHTO M181 – Chain Link Fence Fabric

1.3 SUBMITTALS

Product data for fence fabric, posts, fittings, and gates.
Shop drawings showing layout, heights, gate operation, and anchorage details.

Certificates of compliance with ASTM standards.

1.4 QUALITY ASSURANCE

Fence installer shall have a minimum of 3 years of experience installing commercial fencing.

All materials shall be new and of uniform quality from a single manufacturer.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Fence Height: 6 feet unless otherwise noted on drawings.

B. Fabric:

9-gauge galvanized steel wire; 2-inch diamond mesh.

Galvanized coating: minimum 1.2 oz/ft² per ASTM A392, Class 2.

Option: PVC-coated fabric, 8-gauge core, color **green or black**.

C. Posts and Rails:

End, corner, and line posts: galvanized steel pipe per ASTM F1083 or F1043, Schedule 40.

Top rail: 1.66" OD; line posts: 2.375" OD; terminal posts: 2.875" OD minimum.

Coating: hot-dip galvanized 1.8 oz/ft² zinc coating.

D. Fittings:

Galvanized steel pressed or malleable iron, ASTM A153, zinc coated.

Brace bands, tension bands, and tie wires as required.

Tension wire: 7-gauge galvanized, installed at bottom of fabric.

E. Gates:

Welded tubular steel frame with diagonal truss rods.

Fabric and finish to match adjacent fence.

Hinges: malleable iron or pressed steel, greasable type.

Latch: self-latching, provision for padlock.

F. Concrete:

3000 psi minimum compressive strength at 28 days (ASTM C94).

PART 3 – EXECUTION

3.1 PREPARATION

Verify all fence lines and gate openings with drawings.

Remove vegetation and debris.

Establish grade for uniform fence height.

3.2 INSTALLATION

Install per **ASTM F567** and manufacturer's instructions.

Set terminal and gate posts in concrete footings minimum **12" diameter x 36" deep** (or 1/3 post length).

Line posts spaced at **maximum 10 feet on center**.

Place top rails continuously through line post tops; secure with couplings.

Attach fabric to terminal posts with tension bars and bands at 12-inch spacing.

Secure fabric to line posts with tie wires at 12-inch vertical spacing and to top/bottom rails at 24-inch spacing.

Install bottom tension wire taut and clipped to fabric.

3.3 GATES

Install level, plumb, and free swinging.

Provide diagonal truss rods for gate stability.

Adjust latches and hinges for smooth operation.

3.4 CLEANUP

Remove excess material and debris from site.

Touch up galvanized coatings with zinc-rich paint (ASTM A780).

3.5 FIELD QUALITY CONTROL

Fence alignment: straight and uniform top elevation.

Post plumbness: not to exceed ¼ inch in 10 feet.

Fabric tension: tight and wrinkle-free.

PART 4 – MEASUREMENT AND PAYMENT

Payment shall be made per linear foot of fence, inclusive of all posts, rails, fittings, gates, and concrete foundations, complete in place.

SECTION 32 32 16 – GROUTED ROCK RETAINING WALL

PART 1 – GENERAL

1.1 SUMMARY

This section covers materials, construction, and workmanship required for the installation of **grouted rock retaining walls**, including foundation preparation, placement of stones, and grouting.

1.2 REFERENCES

ASTM C33 – Concrete Aggregates

ASTM C150 – Portland Cement

ASTM C270 – Mortar for Unit Masonry

ASTM C1437 – Flow of Hydraulic Cement Mortar

ASTM C94 – Ready-Mixed Concrete (for grout mix)

ACI 530 / TMS 402 – Building Code Requirements for Masonry Structures

AASHTO M85 – Portland Cement

1.3 SUBMITTALS

Source and sample of rock material.

Grout mix design, including strength and slump.

Method statement for wall construction and drainage provision.

1.4 QUALITY ASSURANCE

Work shall be performed by experienced masons or contractors with a minimum of **3 years** experience in rock wall construction.

Grout test cylinders shall be made and tested in accordance with **ASTM C109**.

PART 2 – PRODUCTS

2.1 ROCK MATERIAL

Type: Durable, angular, sound rock (basalt, limestone, or approved equal).

Size: 8”–24” across the major dimension.

Quality: Free of cracks, seams, clay, or organic materials.

Color: Uniform and consistent throughout wall face.

2.2 GROUT / MORTAR

Cement: ASTM C150 Type I or II Portland Cement.

Fine Aggregate: Clean sand meeting ASTM C33.

Water: Potable and free of impurities.

Mix Proportion: 1 part cement : 2.5 parts sand (by volume), water adjusted for **8–10 inch slump**.

Strength: Minimum **2,500 psi compressive strength at 28 days.**
Optional Admixture: Type "S" masonry cement or waterproofing additive where required.

2.3 DRAINAGE MATERIALS

Weep Holes: 2" diameter PVC or HDPE pipe, spaced **at 6 feet on center** horizontally.
Drainage Layer: 12-inch thick zone of clean ¾" crushed gravel or drain rock behind wall.
Filter Fabric: Nonwoven geotextile per **AASHTO M288**, Class 2.

PART 3 – EXECUTION

3.1 SITE PREPARATION

Excavate foundation trench to firm, level bearing surface below frost depth or as shown on drawings.
Remove all loose soil, roots, or organic material.
Compact subgrade to **95% of ASTM D1557** density.

3.2 FOUNDATION

Where indicated, place a **6" thick concrete leveling pad** (2,500 psi) at base of wall.
Ensure proper alignment and grade before stone placement.

3.3 STONE PLACEMENT

Place larger stones first to form the wall base.
Set stones by hand to minimize voids; use chinking stones to stabilize placement.
Arrange stones to break joints with a minimum **1:4 batter** (3" horizontal setback per 12" vertical).
Maintain uniform face line and course height.
Fill interior voids tightly with smaller stones and grout.

3.4 GROUTING

Grout shall be placed from bottom up to prevent voids.
Use low-pressure pumping or gravity pour method to fill all voids.
Consolidate grout by rodding or tapping; avoid segregation.
Clean stone faces immediately after grouting.

3.5 DRAINAGE AND BACKFILL

Install weep holes through wall face at 6 ft O.C., lowest point of backfill.
Place drainage gravel directly behind wall to full height or minimum 2 ft wide zone.
Wrap gravel with geotextile filter fabric to prevent clogging.
Backfill in 8" lifts compacted to **90% of ASTM D1557**.

3.6 FINISHING

Top of wall shall be neatly capped or sloped to shed water.
Clean exposed stone faces of grout smears before final set.
Remove debris and surplus material from site.

PART 4 – FIELD QUALITY CONTROL

Verify wall alignment, batter, and elevation at 10-ft intervals.
Engineer to inspect wall prior to backfill and final acceptance.
Tolerances:
Vertical plumb: ±1 inch per 10 ft.
Wall batter: ±½ inch per foot of height.

PART 5 – MEASUREMENT AND PAYMENT

Payment shall be made per cubic yard (CY) of completed grouted rock wall, including foundation, drainage, weep holes, and backfill, complete in place.

SECTION 13 34 19 – PRE-ENGINEERED METAL BUILDING SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

This section covers design, materials, fabrication, delivery, and erection of a complete **pre-engineered metal building system (PEMB)** including primary and secondary framing, roof and wall panels, bracing, fasteners, closures, trim, and accessories.

1.2 REFERENCES

AISC 360 – Specification for Structural Steel Buildings
AISI S100 – North American Specification for Cold-Formed Steel
MBMA – Metal Building Systems Manual
AWS D1.1 – Structural Welding Code – Steel
ASTM A36, A992, A572 – Structural Steel
ASTM A653 – Galvanized Sheet Steel
ASTM A123/A153 – Hot-Dip Zinc Coating
ASTM E1646 / E1680 – Air and Water Leakage Tests
ASTM E1592 – Structural Performance of Metal Roof Systems

1.3 SUBMITTALS

Manufacturer's design drawings, sealed by a Professional Engineer (PE) licensed in the project jurisdiction.
Shop drawings showing layout, member sizes, connections, and load diagrams.
Product data for wall and roof panels, fasteners, sealants, and insulation.
Certificates of compliance and structural calculations.

1.4 QUALITY ASSURANCE

Manufacturer shall be certified under **IAS AC472** (Metal Building Systems Accreditation).
Design loads per **IBC (2021)** and **ASCE 7** for wind, snow, seismic, and live loads.
Erection to be performed by an experienced PEMB erector with ≥ 3 years documented experience.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

Approved manufacturers:
Butler, **Varco Pruden**, **Nucor**, **Star**, **Kirby**, or approved equal.

2.2 STRUCTURAL FRAMING

Primary Framing: Welded, tapered built-up I-beams of ASTM A36/A572 Gr. 50, shop-primed.
Secondary Framing: Cold-formed Z- or C-purlins and girts, ASTM A653 Grade 50, galvanized G-90.
Connections: Bolted using high-strength bolts per ASTM A325/A490.
Bracing: Diagonal rod or angle bracing in roof and wall bays for stability.

2.3 ROOF SYSTEM

Panel Type: Standing seam or screw-down metal roof panels, minimum 24 ga. steel.
Coating: Factory-applied baked PVDF (Fluoropolymer Kynar 500 or equal).
Fasteners: Stainless steel or zinc-aluminum coated self-drilling screws with neoprene washers.
Sealant: Butyl tape and non-curing gun-grade sealant at panel sidelaps and endlaps.
Insulation: R-19 fiberglass blanket with vapor barrier; double-layer system optional.

2.4 WALL SYSTEM

Panel Type: Ribbed metal wall panel, minimum 26 ga. galvanized steel with PVDF finish.
Liner Panel : 29 ga. interior finish panel, polyester paint coating.
Fasteners & Sealants: As recommended by manufacturer for weather-tightness.
Insulation: R-13 fiberglass blanket with reinforced vapor barrier or as shown on drawings.

2.5 ACCESSORIES

Flashings, trims, ridge caps, eave closures, gable and base trims, weather-seals, and closures matching panel finish.
Gutters & Downspouts: Formed galvanized steel or aluminum, 26 ga. minimum.
Ventilation: Ridge vents, louvers, or exhaust fans as required.
Doors & Windows: Metal personnel doors, overhead roll-up or sectional doors, framed window openings per schedule.

2.6 COATINGS

Shop Primer: One coat of red-oxide or gray corrosion-inhibiting primer, 1–2 mils dry film.
Touch-Up Paint: Manufacturer's field kit matching primer and finish colors.

PART 3 – EXECUTION

3.1 EXAMINATION

Verify foundation anchor bolt locations, elevations, and alignment before erection.
Foundation tolerance: ± ¼ in. in 20 ft plan location, ± ½ in. elevation.

3.2 ERECTION

Erect framing true to line and plumb per manufacturer's instructions.
Bolt connections snug-tight, then fully tensioned per AISC RCSC Specification.
Install roof and wall panels starting from leeward end; maintain panel alignment and lap direction.
Apply sealants continuously to ensure weather-tight assembly.
Install insulation without voids or compression.
Provide temporary bracing until structure is fully stable.

3.3 FIELD QUALITY CONTROL

Inspect bolted connections, welds, and panel seams for compliance.
Air and water leakage testing per ASTM E1680/E1646 if required.
Replace damaged panels or components with new materials.

3.4 CLEANING AND PROTECTION

Remove metal filings and debris immediately to prevent staining.
Protect panels from contact with dissimilar metals.
Touch up scratches with manufacturer-approved paint.

PART 4 – MEASUREMENT AND PAYMENT

Payment shall be per square foot of completed metal building system, including framing, panels, insulation, accessories, and erection complete in place.

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE (FOR PEB FOUNDATIONS AND RETAINING WALLS)

PART 1 – GENERAL

1.1 SUMMARY

This section includes all labor, materials, equipment, and workmanship necessary for **cast-in-place reinforced concrete**, including:
Foundations and pedestals for **pre-engineered metal building (PEB)** columns
Reinforced concrete retaining walls

Footings, slabs, grade beams, and associated concrete structures

1.2 REFERENCES

ACI 301 – Specifications for Structural Concrete
ACI 318 – Building Code Requirements for Structural Concrete
ACI 350 – Environmental Structures (if applicable)
ASTM A615 / A706 – Deformed Steel Reinforcing Bars
ASTM C33 – Concrete Aggregates
ASTM C150 – Portland Cement
ASTM C94 – Ready-Mixed Concrete
ASTM C260 – Air-Entraining Admixtures
ASTM C494 – Chemical Admixtures
ASTM C231 / C138 – Air and Unit Weight Tests
ASTM C143 – Slump Test

1.3 SUBMITTALS

Concrete mix design reports including proportions, strength data, and admixtures.
Reinforcing steel mill certificates and shop drawings.
Test results for trial batches or field testing (slump, cylinders, air content).
PEB manufacturer's anchor bolt setting plan and layout.

1.4 QUALITY ASSURANCE

Concrete work to conform to **ACI 301 and ACI 117** (tolerances).
Testing laboratory to perform field and strength tests per **ASTM C31/C39**.
Minimum of one test set per 50 cubic yards or one per day of placement.

PART 2 – PRODUCTS

2.1 MATERIALS

Material	Specification
Cement	ASTM C150 Type I or II Portland Cement
Fine Aggregate	ASTM C33 natural sand
Coarse Aggregate	ASTM C33 crushed stone or gravel, 1" max size
Water	Clean, potable
Reinforcing Steel	ASTM A615 Grade 60, deformed bars
Admixtures	ASTM C494, Type A (water reducer) or Type D (retarder)
Curing Compound	ASTM C309, clear or white membrane type

2.2 CONCRETE MIXES

Application	Minimum Compressive Strength (f'c @ 28 days)	Slump (inches)
PEB footings, pedestals, grade beams	4000 psi	4 ± 1
Retaining walls	4000 psi	4 ± 1
Slabs on grade	3500 psi	3 ± 1

Maximum water–cement ratio: **0.45**.
Air content (non-air-entrained concrete): 3 ± 1%.

Use **Type V cement** if exposed to sulfates.

2.3 FORMS AND ACCESSORIES

Formwork: Plywood or steel forms, true to line and grade.

Form release agent: Non-staining type.

Form ties: Removable type leaving holes ≤ ⅞ inch.

Waterstops: PVC or bentonite type at construction joints (where applicable).

2.4 REINFORCEMENT

Clean, free from rust, oil, and mill scale.

Minimum concrete cover:

3" against earth, 2" for formed surfaces, 1½" for slabs.

Tie and support reinforcement per ACI 315.

PART 3 – EXECUTION

3.1 SUBGRADE PREPARATION

Compact subgrade to **95% of ASTM D1557** maximum dry density.

Remove all loose material and standing water before placing concrete.

Verify anchor bolt locations per PEB manufacturer's setting plan.

3.2 FORMWORK

Set forms true to line, plumb, and braced against deflection.

Apply form release prior to concrete placement.

Openings and blockouts as indicated in drawings.

3.3 PLACING CONCRETE

Place concrete continuously between construction joints.

Vibrate thoroughly to remove voids; avoid segregation.

Do not exceed free drop of **5 feet**.

Finish top surfaces to required slope or texture.

3.4 REINFORCED RETAINING WALL CONSTRUCTION

Wall reinforcement to be placed per design drawings with proper lap splices and development lengths.

Provide **weep holes** at 6 ft O.C. and 12" above finished grade at wall toe.

Place **drainage layer (12" min.)** of ¾" clean gravel behind wall, wrapped in filter fabric.

Backfill after concrete reaches **at least 75% design strength**.

3.5 ANCHOR BOLTS FOR PEB

Set anchor bolts accurately using templates provided by PEB manufacturer.

Verify projection, spacing, and alignment prior to concrete placement.

Protect threads from concrete with plastic caps or tape.

3.6 CURING

Cure for **7 days minimum** (3 days if Type III cement used).

Use water curing or curing compound per ASTM C309.

Maintain temperature > 50°F during curing period.

3.7 FIELD QUALITY CONTROL

Perform field tests per ASTM C143 (slump), C231 (air), and C31/C39 (compressive).

Acceptance based on average of three cylinders ≥ f'c.

Remove and replace any concrete not meeting design strength or showing honeycombing.

3.8 FINISHING AND PROTECTION

Exposed surfaces: steel trowel or broom finish as directed.

Patch form tie holes and defects using non-shrink grout.

Protect from premature drying, freezing, or shock loading.

PART 4 – MEASUREMENT AND PAYMENT

Payment shall be made per cubic yard of reinforced concrete, inclusive of formwork, reinforcement, anchor bolts, placement, finishing, curing, and testing complete in place.

SECTION 15 10 00 – MECHANICAL WORKS FOR TURBIDITY TREATMENT PLANT

PART 1 – GENERAL

1.1 SUMMARY

This section includes furnishing, installation, testing, and commissioning of all mechanical works associated with the **turbidity treatment plant**, including but not limited to:

Process and service piping systems

Valves, fittings, supports, and appurtenances

Pumps, blowers, strainers, and mechanical equipment

Interconnections to tanks, filters, and chemical systems

Equipment alignment, anchoring, and mechanical testing

1.2 REFERENCES

AWWA C200 – Steel Water Pipe, 6 in. and Larger

AWWA C111 / C115 – Ductile Iron Fittings, Flanged and Mechanical Joint

AWWA C600 – Installation of Ductile Iron Water Mains

AWWA C651 – Disinfection of Water Mains

AWWA C508 – Swing Check Valves

ASTM A53 / A106 – Carbon Steel Pipe

ASTM D1785 / D2241 – PVC Pressure Pipe

ASME B31.3 – Process Piping Code

API 610 – Centrifugal Pumps for General Service

ANSI / ASME B16.5 – Pipe Flanges and Flanged Fittings

AWWA D100 / D103 – Steel or Bolted Tank Piping Interfaces

1.3 SUBMITTALS

Shop drawings for piping layout, supports, and equipment connections

Manufacturer’s data and O&M manuals for all mechanical equipment

Welding procedures and welder certifications (if applicable)

Pressure test reports, alignment checks, and commissioning certificates

1.4 QUALITY ASSURANCE

All equipment and materials shall be new and of current manufacture.

Installation to be performed by licensed mechanical contractor experienced in water treatment facilities.

Welders shall be certified in accordance with **ASME Section IX**.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

Application	Material	Standard	Joint Type
Raw water / influent lines	Ductile Iron, Class 350	AWWA C151	Mechanical or flanged
Treated water / effluent	Galvanized or Stainless Steel (304/316)	ASTM A312	Flanged or threaded
Chemical feed lines	PVC Schedule 80	ASTM D1785	Solvent weld
Drain and sludge piping	HDPE SDR 17 or PVC Sch. 40	ASTM F714	Butt-fused or solvent
Air scour piping (if applicable)	Galvanized Steel	ASTM A53	Threaded/flanged

2.2 VALVES

Gate Valves: AWWA C509 resilient seat, flanged ends, cast iron body.
Butterfly Valves: AWWA C504, 150 psi rating, epoxy-coated body, SS stem.
Check Valves: AWWA C508 swing-type with lever and weight.
Ball Valves: Full-port brass or SS, 600 psi WOG rating for chemical lines.
Pressure Relief Valves: Factory set, spring-loaded, bronze body.

2.3 FITTINGS AND FLANGES

Ductile iron or stainless-steel fittings rated equal to connected pipe.
Gaskets: EPDM or neoprene; bolts and nuts: SS Type 304 or 316.
Flexible couplings where required for alignment or vibration isolation.

2.4 MECHANICAL EQUIPMENT

Pumps:
Centrifugal, horizontal end-suction or vertical multistage, API 610 compliant.
Material: Cast iron casing with SS impeller and shaft.
Motor: TEFC, 230/460V, 3-phase, 60 Hz, premium efficiency.
Capacity and head as per design data sheets.
Mixers / Agitators: Stainless steel shaft, 316 impeller, TEFC motor.
Air Blowers (if included): Oil-free rotary type, 5–15 psig, with inlet filter and silencer.
Strainers: 316 SS, Y-type or basket type, 1/8" perforation minimum.

2.5 SUPPORTS, ANCHORS, AND ACCESSORIES

Pipe supports: Hot-dip galvanized steel channel or epoxy-coated steel.
Anchor bolts: ASTM F1554 Gr. 36 or stainless steel for chemical area.
Expansion joints: EPDM with stainless steel flanges.
Labels and identification tags per **ASME A13.1** color coding.

PART 3 – EXECUTION

3.1 INSTALLATION

Install piping true to alignment and grade, adequately supported.
Provide unions or flanges at each equipment connection for maintenance.
Ensure all valves are accessible for operation and maintenance.
Isolate dissimilar metals with dielectric unions.
Coordinate with electrical and structural disciplines before installation.

3.2 WELDING AND JOINTING

Weld per ASME Section IX.
Field joints for ductile iron and PVC per AWWA C600.
Apply epoxy or zinc primer to field-welded joints after cleaning.

3.3 EQUIPMENT INSTALLATION

Align pumps, blowers, and mixers on concrete bases with neoprene pads.
Allow for thermal expansion and vibration.
Verify shaft alignment with dial indicator after grouting baseplates.
Connect suction and discharge piping without inducing stress.

3.4 HYDROSTATIC TESTING

Pressure test all piping systems to **1.5 times design operating pressure** or minimum 150 psi.
Hold for 2 hours without pressure loss.
Drain, disinfect, and flush per **AWWA C651** (for potable lines).

3.5 FIELD QUALITY CONTROL AND COMMISSIONING

Verify direction of pump rotation and flow.
Operate all valves through full range.
Record system pressures and flows.
Submit operation and maintenance manual including equipment data, test results, and warranty certificates.

3.6 CLEANUP AND PROTECTION

Remove debris and temporary supports.
Flush all pipelines with clean water.
Protect equipment and openings from dust, debris, and moisture until startup.

PART 4 – MEASUREMENT AND PAYMENT

Payment shall be made per lump sum or by unit rate as indicated in the Bill of Quantities, covering all materials, equipment, installation, testing, and commissioning complete in place.

SECTION 26 00 00 – ELECTRICAL WORKS FOR TURBIDITY TREATMENT PLANT

PART 1 – GENERAL

1.1 SUMMARY

This section includes furnishing, installation, testing, and commissioning of all electrical systems and components for the **Turbidity Treatment Plant**, including:
Main power distribution and control panels
Wiring, conduits, and cable trays
Lighting and grounding systems
Motor control centers (MCC), variable frequency drives (VFDs), and starters
Connection of pumps, mixers, blowers, and instruments
Coordination with mechanical and civil works for conduit embedding and routing

1.2 REFERENCES

IEC 60364 / NEC (NFPA 70) – Electrical Installations
NEMA ICS / AB / 250 – Control Systems and Enclosures
IEEE 80 – Grounding in Industrial and Station Installations
UL 486 / UL 514 / UL 50 – Electrical Connectors, Conduits, and Enclosures
ASTM B3 / B8 – Electrical Copper Conductors
ANSI C2 – National Electrical Safety Code

IEC 60529 – IP Ratings for Electrical Equipment

1.3 SUBMITTALS

Single-line diagrams, cable schedules, and panel layouts.
Shop drawings for switchgear, MCC, panels, and conduits.
Certificates of compliance, product data, and test reports.
As-built drawings and O&M manuals after commissioning.

1.4 QUALITY ASSURANCE

All work shall conform to **NEC** and **local electrical codes**.
Electrical contractor shall be licensed and experienced in water treatment facility installations.
Factory testing of switchgear, MCCs, and panels prior to shipment.

PART 2 – PRODUCTS

2.1 MATERIALS AND EQUIPMENT

All electrical materials shall be **new, factory-tested, and UL or IEC approved**.

A. Power Supply:

Incoming power: 480/277V, 3-phase, 60Hz (verify site requirement).
Transformer (if required): Dry-type, copper-wound, NEMA TP-1, 480/240V or 480/120V.

B. Main Distribution Board (MDB):

NEMA 3R / IP55 rated, wall or floor-mounted, dead front type.
Main circuit breaker: Molded case type with thermal-magnetic trip, 25–35 kAIC.
Copper bus bars, fully insulated and color-coded (R-Y-B).
Metering: Voltmeter, ammeter, phase indicator lights.

C. Motor Control Center (MCC):

NEMA 12 / IP54 enclosure, modular, front-accessible.
Combination motor starters, overload relays, selector switches, indicator lamps.
Provide **soft starters** or **VFDs** for process pumps and blowers as indicated.
Control voltage: 120V AC or 24V DC as required.

D. Distribution and Control Wiring:

Cables: Copper, 600V rated, XLPE or THHN/THWN insulated per **UL 83**.
Minimum conductor size: 2.5 mm^2 (12 AWG).
Color coding:
Red / Yellow / Blue – 3-phase lines
Black – Neutral
Green – Ground
White – Control circuits

E. Conduits and Raceways:

Aboveground: Rigid galvanized steel (RGS) or EMT.
Underground: PVC Schedule 40 / 80 conduit with pull boxes.
Fittings: Watertight type per UL 514.

F. Grounding System:

Copper-clad ground rods, 3/4” dia. × 10 ft length, driven to < 5 ohms resistance.
Bare copper grounding conductor, min. #4 AWG.
Bond all equipment frames, panels, tanks, and structures to grounding grid.

G. Lighting and Receptacles:

Indoor: LED industrial fixtures, 230V, IP65-rated.

Outdoor: LED floodlights, IP66, powder-coated aluminum housing.
Switches and outlets: Industrial grade, weatherproof in wet areas.

H. Control Panels (Local and Remote):

Enclosures: NEMA 4X for outdoor, NEMA 12 for indoor.
Mounted with selector switches, indicators, and control relays.
Prewired and factory-tested prior to installation.

I. Miscellaneous:

Cable trays: Perforated galvanized steel, ASTM A123.
Labels and identification: Engraved phenolic nameplates per ANSI Z535.

PART 3 – EXECUTION

3.1 INSTALLATION

Install conduits concealed where possible, exposed runs neatly aligned.
Separate power and control conduits by minimum 6 inches.
Provide pull boxes every 100 feet and at all direction changes.
Terminate conductors with compression lugs; no wire nuts permitted.
Ensure correct phase rotation for all 3-phase equipment.
Provide flexible metallic conduit to connect vibrating equipment (pumps, blowers).

3.2 GROUNDING AND BONDING

Ground all non-current carrying metal parts.
Interconnect ground rods with bare copper conductor forming a continuous loop.
Measure resistance; value shall not exceed 5 ohms.

3.3 TESTING AND COMMISSIONING

Insulation resistance: Megger test at 500V for control, 1000V for power cables.
Verify phasing, continuity, and absence of short circuits.
Functional test of all MCCs, starters, relays, and interlocks.
Measure and record voltage, current, and power factor for each motor circuit.
Submit final commissioning report.

3.4 IDENTIFICATION AND LABELLING

Label each panel, breaker, switch, receptacle, and cable per drawing designation.
Affix warning labels (“DANGER – 480 VOLTS”) where applicable.
Paint conduit bands per ANSI Z535 or color code for system identification.

3.5 CLEANING AND PROTECTION

Clean all panels and fixtures before energizing.
Cap unused conduits and protect equipment from dust and moisture.
Coordinate energization with Engineer prior to startup.

PART 4 – MEASUREMENT AND PAYMENT

Payment shall be made per lump sum for complete electrical works, including materials, installation, testing, and commissioning, complete in place.