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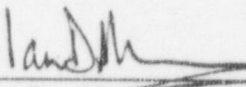
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CONSTRUCTION SPECIFICATION
FOR
NUHOMS® PRECAST
HORIZONTAL STORAGE MODULE

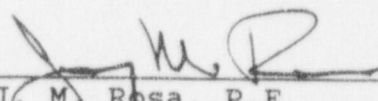
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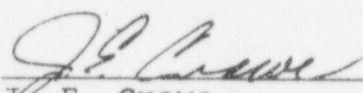
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TITLE: Construction Specification for NUHOMS® Precast Horizontal Storage Module

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PROPRIETARY INFORMATION NOTICE

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GENERAL INFORMATION

This Specification provides the requirements for materials, placement and finishing of concrete, fabrication, welding and coating of steel, inspection, examination, and quality assurance, for the NUHOMS® precast Horizontal Storage Module (HSM). The HSM shall be constructed in accordance with the requirements of ACI-318-83 and the AISC specification for Structural Steel Buildings.

Project Summary

The NUHOMS® system provides for the horizontal storage of spent nuclear fuel in a DSC which is placed in a concrete Horizontal Storage Module (HSM). The NUHOMS® system is designed to be installed at an existing power plant site or an away from reactor site where an Independent Spent Fuel Storage Installation (ISFSI) is needed. Individual DSCs, HSMs and their associated transfer equipment are designed for a range of capacities and fuel types. The requirements of this Specification apply to the NUHOMS® System which is designed to store 24 pressurized water (PWR) or 52 boiling water (BWR) reactor spent fuel assemblies in each HSM.

Description of NUHOMS® Precast Horizontal Storage Module

The major components of the NUHOMS® HSM are as follows:

- A. HSM Base Unit
- B. HSM Roof Unit
- C. DSC Support Assembly
- D. HSM Door
- E. HSM Shield Walls
 - 1. End Shield Walls
 - 2. Back Shield Walls

The HSM base unit and roof unit are cast separately and then assembled to form a complete module unit. The DSC support assembly is a structural steel frame which is installed inside the HSM to provide support for the DSC during transfer and storage. After insertion of a DSC into a module, the HSM door is welded in place to provide secure closure of the HSM and radiological shielding, as well as protection against the elements.

The HSM shield walls provide radiological shielding and protection against tornado generated missiles for the exterior modules within a module array at the ISFSI. The shield walls are precast concrete slabs designed to attach to the modules after placement at the ISFSI. In a double row back-to-back module array configuration,

only the end shield walls are required. For single row module arrays the back shield walls are required as well.

2.0

SCOPE OF WORK

This Specification establishes the requirements for materials, fabrication, inspection, testing, quality assurance, and documentation for the NUHOMS® precast horizontal storage modules (HSMs). The HSMs may be constructed local to the ISFSI location specified in the purchase order, or shipped to this location from the constructor's shop.

2.1

Work Included

The Work set forth by this Specification shall include the following:

- A. The preparation and submittal of a construction plan, schedule, and shop detail and assembly drawings to the Buyer for approval in accordance with the requirements of Section 10.0 of this Specification. These documents shall cover the construction of one HSM including DSC support steel, doors and shield walls (if required).
- B. The preparation and submittal of test reports and records, welding procedures, dimensional certificates and other documentation defined in Section 10.0 of this Specification, to verify that the work conforms to the requirements of the Drawings and this Specification.
- C. The furnishing of materials, fabrication, formwork, welding, coating, placement of concrete, testing, inspection, documentation, and quality assurance of a complete NUHOMS® HSM and/or shield wall as described in the Purchase Order, the Drawings, and this Specification.

2.2

Related Work by Others

The following items related to the NUHOMS® system and NUHOMS® HSM and shield walls are not included and will be furnished by others:

- A. Design and licensing of the NUHOMS® HSM.
- B. Design and preparation of the ISFSI site.

3.0

DEFINITIONS AND ABBREVIATIONS

The following definitions and abbreviations shall apply as used within this Specification.

3.1

Definitions

The following definitions of terms shall apply throughout this document.

- A. **Buyer** is hereby defined as meaning Pacific Nuclear Fuel Services Group, San Jose, California.
- B. **Seller** is hereby defined as meaning the entity awarded the contract for furnishing the HSMs specified herein.
- C. **Owner** is the utility to which the HSM is shipped.
- D. The **Work** is hereby defined as meaning collectively any and all equipment, material, apparatus, item, process, and parts or portions thereof to be supplied by the Seller under this contract.

Definitions of terms used in this Specification shall be as stated in Chapter 1 of ACI 301.

3.2

Abbreviations

The abbreviations applicable to this Specification are defined as follows.

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
ASTM	American Society for Testing and Materials
AWS	American Welding Society
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
DSC	Dry Shielded Canister
HSM	Horizontal Storage Module
ISFSI	Independent Spent Fuel Storage Installation
NRC	Nuclear Regulatory Commission
PCA	Portland Cement Association
SSPC	Steel Structure Painting Council

4.0

SPECIFYING DOCUMENTS

4.1

Codes and Standards

The standards referred to in this Specification are listed below with their serial designation. The latest edition, or revision, at the date of the purchase order shall apply unless a specific year of adoption or revision is given. These standards, or the particular sections thereof referenced, are declared to be a part of this Specification. Any exceptions to these standards shall be approved in writing by the Buyer.

4.1.1

Standards of the American Society for Testing and Materials (ASTM)

- | | |
|------|---|
| A6 | Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use |
| A36 | Specification for Structural Steel |
| A615 | Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement |
| C29 | Standard Test Method for Unit Weight and Voids in Aggregate |
| C31 | Standard Practice for Making and Curing Concrete Test Specimens in the Field |
| C33 | Standard Specification for Concrete Aggregates |
| C39 | Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens |
| C40 | Standard Test Method for Organic Impurities in Fine Aggregates for Concrete |
| C88 | Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate |
| C94 | Standard Specification for Ready-Mixed Concrete |
| C109 | Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or 50mm Cube Specimens) |
| C117 | Standard Test Method for Materials Finer Than 75mm (No. 200) Sieve in Mineral Aggregates by Washing |

- C123 Standard Test Method for Lightweight Pieces in Aggregates
- C127 Standard Test Method for Specific Gravity and Absorption of Coarse Aggregate
- C128 Standard Test Method for Specific Gravity and Absorption of Fine Aggregate
- C131 Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
- C136 Method for Sieve Analysis of Fine and Coarse Aggregates
- C138 Standard Test Method for Unit Weight, Yield, and Air Content (Gravimetric) of Concrete
- C142 Standard Test Method for Clay Lumps and Friable Particles in Aggregates
- C143 Standard Test Method for Slump of Portland Cement Concrete
- C150 Standard Specification for Portland Cement
- C172 Standard Method of Sampling Freshly Mixed Concrete
- C183 Standard Methods of Sampling and Acceptance of Hydraulic Cement
- C192 Standard Method of Making and Curing Concrete Test Specimens in the Laboratory
- C227 Standard Test Method for Potential Alkali Reactivity of Cement Aggregate Combinations (Mortar-Bar Method)
- C231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method
- C260 Standard Specification for Air Entraining Admixture for Concrete
- C289 Standard Test Method for Potential Reactivity of Aggregates (Chemical Method)
- C309 Standard Specification for Liquid-Membrane Forming Compounds for Curing Concrete

- C311 Standard Methods of Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland Cement Concrete
- C494 Standard Specification for Chemical Admixtures for Concrete
- C595 Standard Specification for Blended Hydraulic Cements
- C618 Standard Specification for Flyash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete
- C989 Standard Specification for Ground Iron Blast-Furnace Slag for Use in Concrete and Mortars
- C1017 Standard Specification for Chemical Admixture for Use in Producing Flowing Concrete
- C1064 Standard Test Method for Temperature of Portland Cement Concrete
- C1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregate for Use in Construction and Criteria for Laboratory Evaluation
- D75 Standard Method for Aggregates Sampling
- D512 Standard Test Methods for Chloride Ion in Water

4.1.2

Standards of the American Concrete Institute (ACI)

- ACI 301 Specifications for Structural Concrete for Buildings (Revised 1988)
- ACI 304R Guide for Measuring, Mixing, Transporting and Placing Concrete
- ACI 117 Standard Tolerances for Concrete Construction and Materials
- ACI 306.1 Standard Specification for Cold Weather Concreting
- ACI 311 Recommended Practice for Concrete Inspection
- ACI 318-83 Building Code Requirements for Reinforced Concrete

ACI 347 Recommended Practice for Concrete
Formwork

- 4.1.3 CFR, Title 10, Part 21, "Reporting of Defects and Noncompliance."
- 4.1.4 CFR, Title 10, Part 72, Subpart G, "Quality Assurance."
- 4.1.5 American Welding Society, "Structural Welding Code - Steel," AWS D1.1.
- 4.1.6 AISC, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings."
- 4.1.7 AISC - "Code of Standard Practice for Steel Buildings and Bridges."
- 4.1.8 "Specification for Structural Joints Using ASTM A325 or A490 Bolts" as approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

4.2 Reference Drawings

The Design Drawings specified in the purchase order are hereinafter referred to as Drawings and set forth the extend of the Work to be performed under this contract.

5.0 MATERIALS

5.1 Concrete Material Requirements

Ingredient materials shall meet the requirements of Chapter 3 of ACI 318 and Chapter 2 of ACI 301 as described below.

5.1.1 Cement

Cement shall be Type I or Type II and shall conform to ASTM C150. Type IS blended cement conforming to ASTM C595 may be used in the design mix. The cement shall not contain more than 0.6 percent by weight of alkalis calculated as Na_2O plus K_2O . Other types of cement may be used only as approved by the Buyer for special circumstances.

5.1.2 Aggregates

5.1.2.1 Fine Aggregate

Fine aggregate shall conform to ASTM C33.

5.1.2.2 Coarse Aggregate

Coarse aggregate shall conform to ASTM C33.

5.1.3 Mixing Water and Ice

Mixing water and ice shall be fresh, clean and essentially free from deleterious materials such as oil, acid, vegetable and organic matter. Nonpotable water may be used if it produces mortar cubes having 7 and 28 day strengths equal to at least 90% of the strength of similar specimens made with distilled water. The strength comparison shall be made on mortars, identical except for the mixing water, prepared and tested in accordance with ASTM C109.

5.1.4 Admixtures

Admixtures shall conform with the applicable ASTM Standard:

- a) Air-entraining admixtures. ASTM C260
- b) Water-reducing, high range water-reducing, retarding and accelerating admixtures. ASTM C494
- c) Plasticizing admixtures. ASTM C1017
- d) Pozzolanic admixture. ASTM C618 except that the maximum value for loss on ignition shall be 6%.
- e) Blast furnace slag admixture. ASTM C989, Grade 120

5.1.5 Storage of Ingredient Materials

Ingredient materials shall be stored in accordance with the requirements of Section 2.5 of ACI 301, the detailed recommendations of Chapter 2 of ACI 304R and Section 3.7 of ACI 318.

5.1.6 Concrete Mixes

5.1.6.1 Mix Proportions

Concrete mixes shall be developed in accordance with Chapter 4 of ACI 318. The Seller shall be responsible for the selection of proportions which will provide the necessary workability and meet the requirements of this Specification. Materials used in determining proportions shall be the same as those used in the work.

5.1.6.2 Strength

The required average strength shall be according to Paragraph 4.3.2 of ACI 318.

5.1.6.3 Air Content

Unless otherwise approved by the Buyer for specific cases, all mixes shall be air-entrained. Total air content percent by volume shall be 3.5% to 6.5%.

5.1.6.4 Chloride Content

The water soluble chloride ion (Cl^-) content of the concrete shall not exceed 0.10 percent by weight of the cement.

5.1.6.5 Types of Concrete Mixes

Proportions shall be developed for the following mixes and submitted to the Buyer for approval:

Mix Design- nation	Maximum Slump	7-day Compressive Strength	28-day Compressive Strength (f'c)	Coarse Aggregate ASTM C33 Size No.	Maximum W/C (by weight)
A1	4"	3000 psi	5000 psi	57	0.5
A2	8"	3000 psi	5000 psi	57	0.5

The 8 inch maximum slump mix shall be obtained by the addition and thorough mixing of plasticizing admixture

into a well proportioned conventional mix having a slump of 2 to 4 inches.

Mixes shall be proportioned to obtain a minimum weight density of 145 lbs./ft³ in a plastic state.

5.1.7 Production and Delivery of Concrete

The production and delivery of concrete, including the measuring of materials, the batching, mixing and transporting of concrete and the batch ticket certification, shall conform to ASTM C94 and Chapter 5 of ACI 318 unless otherwise required by this Specification or modified herein.

5.1.7.1 Plant Equipment and Facilities

Plant equipment and facilities shall conform to "Certification of Ready Mixed Concrete Production Facilities (Checklist with Instructions)" of the National Ready Mixed Concrete Association unless otherwise permitted by the Owner.

5.1.7.2 Mixing

Mixers used shall produce job-site concrete which meets the uniformity requirements of ANNEX A1 of ASTM C94.

When concrete with a plasticizing admixture is batched, the batching and mixing sequence shall be such that the plasticizing admixture is added to a concrete mixture which meets the uniformity requirements of ASTM C94. Once the admixture is added, the concrete shall be thoroughly mixed such that the plasticized concrete meets the ASTM C94 uniformity requirements.

5.1.7.3 Concrete Temperature

The temperature of plastic concrete, as placed, shall not exceed 90°F; during cold weather the temperature of the concrete when delivered shall comply with Table 7.6.1.1 of ACI 301.

5.1.7.4 Delivery Tickets

Delivery tickets with each batch shall comply with Section 16 of ASTM C94. The additional information listed in part 16.2 shall also be included on the ticket. Batch tickets shall be provided to the Buyer for each batch.

5.2 Reinforcing Steel Materials

Reinforcing steel materials shall conform to ASTM specification A615, Grade 60 unless otherwise specified on the Drawings.

5.3 Structural Steel Materials

Structural steel materials shall conform to ASTM specification A36 unless otherwise specified on the Drawings.

6.0 HSM CONSTRUCTION REQUIREMENTS

6.1 Tolerances for Concrete Construction

Tolerances for concrete construction, including tolerances on structure dimensions, concrete finishing tolerances, and tolerances on placing of reinforcing and embedded materials, shall be in accordance with ACI 117 except where this Specification or the Drawings specify other tolerances.

6.2 Formwork

6.2.1 General

All poured concrete shall be formed. Chamfer strips shall be provided in the exterior angle of forms to produce a 3/4 inch chamfer on all exposed concrete edges unless otherwise shown or noted on the Drawings. Formwork shall comply with the requirements of Chapter 6 of ACI 318 and the recommendations of ACI 347.

6.2.2 Material

6.2.2.1 Form Material

Forms shall be wood or metal that are of sufficient strength and rigidity and have a surface suitable to produce a finish as required by Section 6.7 of this Specification. The use of vendor designed formwork meeting these requirements is permitted.

6.2.2.2 Form Release Agents

Form release agents shall be non-oil based and applied in strict accordance with the manufacturer's printed instructions.

6.2.2.3 Accessories

Ties, hangers and other form accessories to be partially or wholly embedded in the concrete shall be of a commercially manufactured type.

6.2.3 Design and Installation

The design and installation of formwork shall be the responsibility of the Seller and shall be in accordance with Chapter 4 of ACI 301.

6.2.4 Removal of Formwork

Form removal shall be in accordance with the recommendations of Chapter 4 of ACI 301, shall assure the complete safety of the structure, and prevent damage to the concrete. The minimum time permitted prior to form removal shall be established, by the Seller, using either the times specified below, or results from field cured cylinders. The Seller shall be responsible to ensure that all concrete surfaces are cured in accordance with Section 6.8, and have adequate thermal protection.

Field cured cylinders shall be made in accordance with ASTM C31 and shall be immediately protected from cold weather until they can be placed under the same protection provided for those portions of the structure they represent. After removal, the specimens shall be capped and tested in accordance with the applicable sections of ASTM C31 and C39. At least 3 cylinders shall be cast from the last 100 cu. yd. of a pour for side form removal, and at least 3 cylinders per 100 cu. yd. for bottom form and shoring removal.

The minimum strength of the field cured cylinders for side form removal shall be not less than 1000 psi. The minimum strength of the field cured cylinders for removal of bottom forms or shoring shall be not less than 3500 psi. Alternatively the stripping time for forms may be established from the following table.

<u>Type of Formwork</u>	<u>Time for Formwork to Remain in Place</u> (Average Mean Daily Temp. Outside Air)		
	<u>60°F or Greater</u>	<u>50°F to 60°F</u>	<u>40°F to 50°F</u>
Side forms	18 hours	36 hours	2 days
Bottom forms and shoring	14 days	18 days	24 days

6.3 Reinforcement

6.3.1 General

The grade, type and details of reinforcing steel shall be in accordance with the Drawings. The Seller shall develop rebar cut and bend lists in accordance with the Drawings. All bar bends and fabrication tolerances shall be in accordance with CRSI "Manual of Standard Practice," Chapters 6 and 7.

Placement of reinforcement shall be in accordance with Section 5.7 of ACI 301 except as modified herein. Bending of reinforcing bars partially embedded in hardened concrete is permissible only in situations absolutely necessary to facilitate subsequent construction work and shall be approved, in writing by the Buyer, prior to bending.

6.3.2 Rebar Supports

Wire bar supports shall comply with Section 5.3 of ACI 301. Unless otherwise approved, spacers shall be factory-made wire bar supports. Tie wires shall be black annealed wire, 16g or heavier.

Templates for wall dowels are not required if prepour inspection insures proper placement of dowels.

6.4 Joints and Embedded Items

6.4.1 Construction Joints

The Seller may choose to construct the HSM base unit in several pours. Construction joint locations for such pours shall be submitted for the Buyer's written approval. Construction joints shall incorporate either keys or a roughened joint detail. When roughened joints are used, the roughness shall be achieved by green cutting, sand blasting, water blasting, surface retarders, mechanical scarifiers or other means approved by the Buyer. The surface of concrete joints shall be thoroughly cleaned and all laitance removed. Construction joints shall be cured in accordance with Section 6.8 of this Specification except that curing compound shall not be used unless it is thoroughly removed before placing adjacent concrete.

6.4.2 Embedded Items

The location of some embedments are critical to the safe operation of the HSM and ISFSI. As shown on the drawings, special tolerances have been assigned to such embedments. It is essential that these tolerances be met during construction. Embedded items shall conform with the drawings, purchase order specifications and Chapter 6 of ACI 301.

6.5 Placement of Concrete

The placement of concrete, consisting of preparation before placing, conveying, depositing, protection and bonding, shall be in accordance with Chapter 8 of ACI

301 and Chapter 5 of ACI 318 except as specified herein.

In cases of conflicting requirements between provisions of ACI 301 and other referenced standards, ACI 301 provisions shall govern.

All snow, ice, and frost shall be removed from the surface against which concrete is to be placed. Reinforcement shall be free of ice. Concrete shall not be placed against frozen surfaces.

The temperature of the plastic concrete, as placed, shall not exceed 90°F. During cold weather, placement of concrete shall comply with the requirements of Section 5.1.7.3 of this Specification.

Water may be added to concrete at the point of placement, but in no case shall the total amount of water added at the jobsite and batch plant exceed the quantity specified by the design mix. When water is added, additional mixing of the concrete shall be performed in accordance with paragraph 11.7 of ASTM C94. The maximum slump after the addition of water at the site shall be 4 inches.

6.6 Repair of Surface Defects

Unless otherwise specified or permitted by the Buyer, tie holes, honeycombs, and other concrete surface defects shall be repaired as soon as practicable after form removal, at such times and in such manner as will not delay, interfere with or impair the proper curing of the concrete.

All tie holes and repairable defects shall be repaired in accordance with Chapter 9 of ACI 301 unless otherwise specified or permitted by the Buyer.

6.7 Finishing

Surfaces of concrete shall be finished in accordance with Chapters 10 and 11 of ACI 301. All formed surfaces shall be the as-cast smooth form finish in accordance with Section 10.2.2 of ACI 301 unless otherwise noted on the drawings. The type finish and tolerance for other surfaces shall be in accordance with the drawings.

Curing

Concrete shall be cured and protected in accordance with Chapter 12 of ACI 301. Curing compounds, if used, shall comply with the requirements of ASTM C309. The curing compound shall be applied in strict accordance with the manufacturer's printed instructions. The curing compound shall be approved, by the Buyer, prior to use. Provisions shall be made to protect concrete during cold weather in accordance with ACI 301.

7.0 STRUCTURAL STEEL REQUIREMENTS

7.1 Fabrication

Fabrication and erection shall conform to the applicable provisions of AISC Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings except as noted otherwise on the Drawings. Fabrication tolerances shall be in accordance with Standard Mill Practice as defined by The Code of Standard Practice for Steel Buildings and Bridges and ASTM A6 except as shown on the Drawings.

7.1.1 Methods of Fabrication

Members may be torch cut providing the cuts are reasonably free from notches or gouges; occasional notches or gouges more than 3/16" deep shall be removed by grinding or weld repaired in accordance with Section 7.1.2 of this Specification. Holes shall be either drilled, subpunched and reamed, or burned and reamed. Burned holes that are not reamed shall not be permitted.

7.1.2 Removal and Repair of Defects

Defects in plates and structural steel discovered during installation or inspection shall be repaired using ASTM A6 as a guideline.

7.2 Welded Connections

7.2.1 Type of Welding

All welding shall be by the electric arc process. Complete penetration shall be used for all groove welds unless otherwise specifically indicated on the drawings. The length of intermittent welds may be increased and/or the pitch may be decreased. Tolerances for the length of fillet welds shall be +1", -1/4" (cumulative) for each line of weld (not applicable to intermittent welds). Welds shall not be made across flanges of any members unless specifically indicated on the drawings; if so indicated, care should be taken to prevent undercutting or other damage that would significantly reduce flange area.

7.2.2 Welder Qualifications

All welders shall be qualified in accordance with AWS D1.1. It shall be verified that welders have passed

the required qualification tests for the type work specified on the drawings.

7.2.3 Procedures

All welding shall be in accordance with procedures qualified in accordance with AWS D1.1.

7.2.4 Electrodes

Electrodes shall conform to the applicable requirements of the AISC Manual, and/or AWS D1.1.

7.2.5 Welding at Low Temperatures

All welding shall conform to the applicable requirements of AISC Manual, AWS D1.1, and the following:

- A. When welding to a steel embedment in concrete greater than 3/4" in thickness, preheat surface of embedment to 200°F (min) and maintain throughout the welding process.
- B. When base metal temperature is at or below 32°F and no other preheat or interpass temperatures are specified, preheat base metal to at least 70° before tack welding or welding, and maintain throughout welding process.

7.3 Bolted Connections

All bolted connections shall be fabricated and erected as FRICTION TYPE connections using high strength bolts unless otherwise specified on the drawings. High strength bolted connections shall conform to AISC Specification for Structural Joints using ASTM A325 or A490 Bolts.

All bolts for bolted connections shall be high strength bolts unless specified otherwise on drawings. A490 and galvanized A325 bolts shall not be reused. Other A325 bolts may be reused provided they are not damaged. No welding to high strength bolts is allowed without Buyer approval and preheat requirements.

7.4 Stud Connectors

All welded stud connectors indicated on the drawings shall meet the requirements of this Specification and shall be installed in strict accordance with the

manufacturer's instructions, using suitable stud welding equipment as recommended by the manufacturer.

7.5

Embedments

- A. Welding to structural reinforcing steel is not allowed.
- B. Mild steel embedments may be tack welded to the carrier bar system (used to support the structural reinforcing steel) in order to maintain the position of the embedment during concrete placement. Welding to any other type steel embedment is prohibited unless noted on the drawings or approved by the Buyer.
- C. Erection shall conform to the AISC Specification and Code of Standard Practice except as noted on the drawings.

7.6

Erection Tolerances and Procedures

Erection tolerances shall conform to the AISC Specifications and Code of Standard Practice except as noted on the drawings. The straightness and location tolerances for the DSC support structure and its embedments are critical to the safe operation of the ISFSI. As such, the drawings describe the required tolerances for these items. Variations from these tolerances will not be accepted.

7.7

Surface Finish and Coatings

Surface finishes and shop coatings shall be in accordance with the Drawings and Attachment A to this Specification. The Seller may submit alternate coatings for Buyer approval. The coating requirements shown in Attachment A shall be used unless an alternate is approved by the Buyer.

8.0 TESTS AND INSPECTIONS

8.1 Concrete Tests

The Buyer shall have full authority to conduct inspections or request additional tests as necessary to maintain control.

8.1.1 Tests on Concrete Ingredient Materials

8.1.1.1 Qualification of Ingredients Prior to Construction

To assure that ingredient materials meet the specification requirements, the following preconstruction qualification tests shall be performed on the materials proposed for use. The Seller shall be responsible for compiling this documentation and for having these tests performed. Tests on cement and admixtures may be performed by the supplier of the particular material. All testing shall be performed by a testing agency qualified in accordance with ASTM C1077 and approved by the Buyer.

A. Cement

Tests referenced in ASTM C150 for physical and chemical properties shall be performed. Tests referenced in ASTM C595 and C989 shall be performed for all blended cement mixes.

B. Aggregates

Perform the following tests:

<u>Required Test</u>	<u>Sand</u>	<u>Stone</u>
Gradation	ASTM C136	ASTM C136
Fineness Modulus	ASTM C136	-
Material Finer than No. 200 Sieve	ASTM C117	ASTM C117
Organic Impurities	ASTM C40	-
Lightweight Pieces	ASTM C123	ASTM C123
Friable Particles	ASTM C142	ASTM C142
Specific Gravity and Absorption	ASTM C128	ASTM C127
Los Angeles Abrasion	-	ASTM C131
Potential Reactivity by either the Chemical Method or Mortar-Bar Method	ASTM C289 ASTM C227	ASTM C289 ASTM C227
Soundness	ASTM C88	ASTM C88
Unit Weight	ASTM C29	ASTM C29

C. Mixing Water and Ice

Tests referenced in Section 5.1.3 of this Specification shall be performed. The chloride content shall also be determined in accordance with ASTM D512.

D. Water-Reducing, High Range Water-Reducing, Plasticizing, Retarding, Accelerating and Air-Entraining Admixture

Test documentation from the admixture manufacturer verifying that the admixture complies with the applicable ASTM Standard as listed in Section 5.1.4 of this Specification, an infrared analysis, and the chloride content of the admixture shall be furnished.

E. Pozzolanic Admixtures

The tests for physical and chemical properties referenced in ASTM C618 shall be performed.

8.1.1.2 Tests on Ingredients During Construction

During the course of construction, tests shall be performed on the ingredient materials to ensure continued compliance with this Specification. These tests shall be performed on samples taken from the lot or batch of materials used in the production of the concrete supplied to the site. The tests required by this section shall be the responsibility of the Seller. The task of performing these tests shall be subcontracted to a Testing Laboratory qualified in accordance with ASTM C1077. Cement, flyash and admixture tests may be performed by the manufacturer or supplier of each ingredient.

Tests shall be evaluated in accordance with Section 5.1 of this Specification. All test and inspection results shall be submitted to the Buyer.

A. Cement

Samples of cement shall be obtained from each shipment in accordance with ASTM C183 and tested for conformance with ASTM C150, or C595 if appropriate, at the normal testing frequencies indicated in ASTM C183.

B. Aggregates

Fine and coarse aggregates shall be sampled in accordance with ASTM D75 and tested for gradation

and fineness modulus in accordance with ASTM C136 and material finer than No. 200 sieve in accordance with ASTM C117. Tests shall be performed for at least every 500 tons used of each.

C. Mixing Water And Ice

Nonpotable mixing water and ice shall be tested annually for compressive strength of mortar cubes and compared to the strength of similar specimens made with distilled water. Tests shall be performed in accordance with ASTM C109. In addition to strength test, the chloride content should also be determined annually. The frequency of performing tests shall be increased if water or ice quality is suspect or as necessary to maintain control.

D. Water-Reducing, High Range Water-Reducing, Plasticizing, Retarding, Accelerating, And Air-Entraining Admixtures

A certification of compliance shall be obtained for each shipment from which admixtures are used in the production of concrete delivered to the site. This certification shall indicate that each identifiable and separate lot or batch contained in the shipment has been tested and the results found satisfactory to assure that ingredient content is within established tolerable limits determined by the manufacturer to satisfy requirements of tests prescribed in ASTM C494, ASTM C260, or ASTM C1017 as applicable.

The chloride content level of each shipment shall also be provided.

E. Pozzolanic Admixtures

Flyash and pozzolans, if used, shall be sampled and tested in accordance with ASTM C311. The frequency and number of tests shall comply with Section 6 of ASTM C311.

8.1.2 Trial Batch Qualification Tests

The tests listed below shall be performed on trial batches used to establish strength relationships in accordance with the applicable ASTM Standard. If trial batches are not used to establish proportions, the test shall be performed on the proposed mix design to verify

the strength producing capability of the mixture. These tests shall be performed using the least favorable combination of mixing water and air content. Ingredient materials shall be added in the same manner and at the same time during the batching and mixing sequence as they will be added on the job. Test results shall be submitted to the Buyer.

<u>TEST</u>	<u>ASTM STANDARD</u>
Air Content of Freshly Mixed Concrete by the Pressure Method	C231
Slump of Portland Cement Concrete	C143
Unit Weight, Yield, and Air Content (Gravimetric) of Concrete	C138
Compressive Strength of Cylindrical Concrete Specimens (7 and 28 days)	C39

Cylindrical specimens shall be made and cured in accordance with ASTM C192 or ASTM C31 as appropriate.

8.1.3 Concrete Testing and Inspection During Construction

The tests listed below shall be performed on random samples of concrete taken at receiving in accordance with the requirements of ASTM C172. Unless otherwise allowed by the Buyer, the sampling point shall be at the truck mixer/agitator discharge if the last piece of conveying equipment is a chute, bucket, conveyor, or similar equipment and at the pump line discharge if the concrete is pumped. All tests, analyses and inspections specified herein shall be the responsibility of the Seller. Tests and inspections shall be performed by an ACI Concrete Field Testing Technician Grade I or higher.

If tests indicate that the concrete does not meet specification requirements, the Buyer shall be notified. Concrete shall be verified to be back within specification before work resumes.

8.1.3.1 Strength Tests

Six compressive strength test specimens shall be made from a sample of fresh concrete obtained for each 100 cubic yards, or fraction thereof, of each concrete mix placed each day.

The test specimens shall be made and cured in accordance with ASTM C31.

The test specimens shall be tested in accordance with ASTM C39. Two test specimens shall be tested at the age of 7 days for information and two shall be tested at 28 days for acceptance. The remaining two test specimens are spares and may be tested if deemed necessary.

8.1.3.2 Slump Tests

Slump tests shall be performed when compressive strength test specimens are cast. In addition, slump tests shall be performed as frequently as required for control, but not less than one test for every 50 cubic yards of concrete placed in one day for each mix designation. A slump test shall be performed on the first load of concrete each day. Slump tests shall conform to ASTM C143.

When plasticizing admixtures are used, slump tests shall be performed on the first load of concrete prior to the addition of the admixture to verify that the slump of the conventional mix is between 2 and 4 inches. This test shall be performed at the truck mixer discharge on a sample of the concrete taken from the first part of the truck. Slump tests shall be performed on the plasticized concrete at the frequencies specified above. The slump of the conventional mix prior to the addition of the plasticizing admixture shall be checked whenever the mixing water content of the mix is adjusted.

8.1.3.3 Air Content Tests

Air content tests shall be performed when compressive strength test specimens are cast. Air content tests shall conform to ASTM C231.

8.1.3.4 Determination of Temperature

The temperature of the concrete shall be determined when compressive strength specimens are cast and for every 50 cubic yards of concrete placed in one day for each mix designation. Temperature tests shall be performed on the first batch of concrete produced each day. Tests shall be performed in accordance with ASTM C1064.

8.1.3.5 Concrete Acceptance Parameters

The Seller shall be responsible for the quality of the concrete for the time period specified in Section 6.2 of ASTM C94.

The acceptance criteria for the concrete mixes are given in Section 5.1.6.5 of this Specification. The following variations from the target values are acceptable.

- A. Acceptance criteria for the 28 day-compressive strength test results shall be in accordance with Section 4.7 of ACI 318. The strength level of the concrete will be considered satisfactory provided the average of all sets of three consecutive strength test results equal or exceed the specified compressive strength, and no individual strength test result falls below the specified compressive strength by more than 500 psi.
- B. A tolerance of up to 1 inch above the indicated maximum slump shall be allowed for one batch in any five consecutive batches tested.
- C. A maximum air content of 7.0% is acceptable provided the following additional tests are made for each truck load of concrete with an air content between 6.5% and 7.0%:
 - confirm unit weight exceeds 145 lb./cu. ft.
 - make one additional set of cylinders for strength tests per Section 8.1.3.1.

8.1.3.6 Unit Weight and Yield

The unit weight and yield of the freshly mixed concrete shall be determined once during each day of production in accordance with ASTM C138.

8.1.3.7 Inspection of Concreting

The Seller shall assign Inspectors at the location of each pour to verify the following:

- A. The foundation upon which concrete is to be placed has been properly cleaned and prepared.
- B. Formwork, reinforcing and embedded items meet specification and design drawing requirements.
- C. Specified tests of concrete have been performed.

- D. The specified class of concrete is placed.
- E. Concrete is properly conveyed, placed and consolidated into place.
- F. Specified finishes and repairs are made.
- G. Concrete is properly cured and protected.

Inspections should comply with the recommendations of ACI 311 as appropriate.

8.2 Structural Steel Tests and Inspections

8.2.1 Weld Examination

- A. All welds shall be visually examined by the welding inspector. Acceptance criteria shall be in accordance with AWS D1.1, Section 8.15.
- B. Repair of defects shall be in accordance with Section 3.7 AWS D1.1 as a minimum.

8.2.2 Bolt Inspection

All bolts required for all connections shall be inspected as required by AISC Specification for Structural Joints using ASTM A325 or A490 bolts, Paragraph 6 or the drawings.

8.2.3 Stud Connector Inspection

Workmanship, preproduction testing, operator qualification, erection and production control verification and inspection for stud connectors shall be in accordance with Section 7, "Stud Welding" of AWS D1.1. The welding inspector shall confirm that the application qualification and production control tests and inspections of Sections 7.6, 7.7 and 7.8 of ASW D1.1 are completed by the Seller.

8.3 Reinforcing Steel Testing

Reinforcing shall be tested in accordance with ASTM A615 except that one full section test from each heat for each bar size shall be required.

Reinforcing bars with rust, mill scale, or a combination of both shall be considered as satisfactory, provided the minimum dimensions (including height of deformations) and weight of a hand wire brushed test

specimen are not less than the applicable ASTM
Specification requirements.

QUALITY ASSURANCE REQUIREMENTS

The materials used to fabricate the HSMs shall be purchased as non-safety related from approved suppliers. This material shall be subjected to receipt inspections to verify compliance with the technical attributes defined in this Specification.

The Seller is not required to have an approved quality assurance program. Receipt inspections will be performed by the Buyer or the Buyer's designee. However, this does not relieve the Seller of the responsibility to provide a quality product meeting the requirements of the Drawings and this Specification.

10.0

DOCUMENTATION REQUIRED

This Specification covers material for structures which contain radioactive materials and they must meet the quality standards of this Specification and the referenced codes and standards. This quality shall be proven by full documentation as required.

10.1

HSM Concrete Documentation

The Seller shall furnish the following quality program documents to the Buyer:

- A. Qualification test results on ingredients per Section 8.1.1.
- B. Mix proportions for each concrete mix.
- C. Trial batch qualification test results of Section 8.1.2.
- D. Delivery tickets per Section 5.1.7.4.
- E. Slump, temperature, air content, plastic unit weight and cylinder strength tests per Section 8.1.3.

During production of HSM concrete, the Seller shall provide test documentation on cement, admixture, aggregates, mixing water and flyash to the Buyer certifying the quality of the material actually used in the concrete.

10.2

Structural Steel Documentation

The following shall be developed and submitted to the Buyer by the Seller or the Testing Agent as appropriate:

- A. Welder Qualifications and Weld Procedure Qualifications
- B. Test and Inspection Records
- C. Test and Examination Results
- D. Certified Mill Test Reports or Certificates of Conformance for Materials

Reinforcing Steel Documentation

The Seller shall furnish the following quality program documents to the Buyer:

- A. Test Reports for tests indicated in Section 8.3
- B. Certified mill Test Reports for each heat of steel delivered showing physical and chemical analyses.

The Seller shall furnish the required documentation with each shipment. The Seller is responsible for assuring the documentation required by this Specification is provided to the Buyer.

ATTACHMENT A
COATING REQUIREMENTS

COATING REQUIREMENTS

1.0 SCOPE

This Specification defines the method of surface preparation and materials application for coating carbon steel surfaces where maximum protection is required and normal operating temperatures can vary between 150°F and 250°F.

Steel structures Painting Council Specification SSPC-PA-1-82 "No. 1 Shop, Field, and Maintenance Painting" shall govern minimum standards not covered by this Specification.

2.0 COATING SYSTEMS

Surface Preparation: See Section 4.0

Prime Coat: Inorganic Zinc Rich Primer @ 2.0 DFT Min.
6.0 DFT Max.

Finish Coat: High Build Epoxy Enamel @ 5.0 DFT
Minimum 7.0 DFT

3.0 APPROVED MATERIALS

The following coating materials and thinners manufactured by the Valspar Corporation are approved for use with this Specification

13-F-12 MZ-7 Inorganic Zinc Rich Primer
7-T-32 Thinner (fast evaporating) or
7-T-35 Thinner (slow evaporating)

76 Series High Solids Epoxy Enamel
7-T-35 Thinner

Alternatively, the following coating materials manufactured by the Carboline Corporation are approved for use with this Specification

Carbo Zinc 11

Phenoline 305

4.0 SURFACE PREPARATION

Metal surfaces shall be prepared by abrasive blast cleaning in strict accordance with Structural Steel Painting council SSPC-SP6-84 (Commercial Blast Cleaning).

No surface preparation shall be allowed when the temperature is within 5°F of the dew point or above 90% relative humidity. Surface areas exposed to condensation or moisture prior to priming shall be reblasted.

The surface shall be free of excessive grease or oil prior to blast cleaning. Organic solvents, alkaline solutions, steam, hot water with detergents, or other systems that completely remove dirt, oil, grease, etc. may be used.

The grit shall be sharp silica sand, steel slag grit, similar or equal to 16-35 mesh flint silica to give a 1.0 to 3.0 mils anchor pattern. No polished surfaces shall be allowed.

Contaminated sand or grit shall not be used for finished work.

Round sharp edges and smooth sharp welds.

All visible burrs, slivers, scabs, and weld splatter shall be removed after blast cleaning.

After blast cleaning, the prime coat shall be applied within 8 hrs. and/or before the surface is exposed to dew point conditions or before any rust blooms begin to form. Reblast all surfaces that exceed these conditions before applying prime coat.

Remove all traces of grit, dust, grease and foreign matter after blast cleaning and prior to application of each coat of material by solvent cleaning, high pressure air or brush.

Minimum cleaning is as defined in Section 2 and Section 3.2 of SSPC-SP6-84. SSPC-VIS-1-82 shall not be used to establish Visual standards.

5.0 APPLICATION PROCEDURES

5.1 General Requirements

Paint that has been stored at low temperatures shall be brought up to minimum of 70°F before mixing and thinning.

Prior to thinning or application, all material shall be thoroughly mixed with a power mixer to ensure the breaking apart of all lumps, complete dispersion of all settled pigments, and a uniform composition.

Sprayable mixed material shall be strained through a 30-50 mesh strainer prior to application.

Thinner shall be as recommended by the coating manufacturer.

Storage, mixing, thinning, percentage, and induction time shall be in accordance with the manufacturer's recommendations for the product specified.

Mixed material shall be applied within the maximum pot life specified by the manufacturer for the product selected or prior to any significant change in viscosity, whichever comes first.

Use of additional thinner to lower the viscosity after the mixed pot life has been exceeded shall not be allowed.

Minimum DFT shall be as specified in Section 2 when inspected in accordance with SSPC-PA2-82.

Applied coatings shall be free of runs, sags, drops, ridges, mudcracking, embedded foreign matter and other indications of improper application techniques.

Overspray shall be removed by light sanding followed by solvent wiping with clean cloths.

5.2

Application of 13-F-12

No material shall be applied when the surface or air temperature is below 35°F or above 110°F, when the relative humidity is within 5°F of the dew point. Material shall be applied by spray application. The minimum DFT per coat and workmanship requirements of this Specification shall be met.

Prior to topcoating, each coat shall be allowed to dry in strict accordance with the following minimum guidelines unless accelerated curing, as detailed, is used:

TEMPERATURE

RELATIVE HUMIDITY	40°F	50°F	60°F	70°F	80°F	90°F
40%	72 hr.	66 hr.	60 hr.	54 hr.	48 hr.	42 hr.
50%	66 hr.	60 hr.	54 hr.	48 hr.	42 hr.	36 hr.
60%	60 hr.	54 hr.	48 hr.	42 hr.	36 hr.	30 hr.
70%	54 hr.	48 hr.	42 hr.	36 hr.	30 hr.	24 hr.
80%	48 hr.	42 hr.	36 hr.	30 hr.	24 hr.	18 hr.
90%	42 hr.	36 hr.	30 hr.	24 hr.	18 hr.	12 hr.

For accelerated curing of inorganic zinc the following procedure shall be adhered to:

- A. Wait 30 minutes after priming.
- B. Hose for five minutes with fine spray mist of water.
- C. Wait one hour and hose again for 5 minutes with fine spray mist of water.
- D. Allow to dry overnight or 8 hours minimum prior to recoating.

5.3

Application of 13-R-56

No material shall be applied when the surface or air temperature is below 50°F or above 110°F, when the relative humidity is above 90% or when the temperature is within 5°F of the dew point.

Material shall be applied by brush, spray, or roller application provided the minimum DFT per coat and workmanship requirements of this Specification are met.

Prior to topcoating, each coat shall be allowed to dry in strict accordance with the following minimum guidelines:

	<u>Spray</u>	<u>Brush</u>
Below 50°F	Do not recoat	Do not recoat
50°F - 70°F	10 hr. - 8 hr.	48 hr. - 16 hr.
70°F - 90°F	8 hr. - 3 hr.	16 hr. - 8 hr.
90°F - 110°F	3 hr.	8 hr.

5.4 Application of 76 Series

No material shall be applied when the surface or air temperature is below 50°F or above 110°F, when the relative humidity is above 90% or when the surface or air temperature is within 5°F of the dew point.

Material shall be applied by brush, spray, or roller application provided the minimum DFT per coat and workmanship requirements of this Specification are met.

A barrier coat thinned approximately 30% may be applied at a dry film thickness of 1.0 mils to seal porosity of inorganic zinc primer prior to applying a full coat.

Prior to topcoating, each coat shall be allowed to dry in strict accordance with the following minimum guidelines:

	<u>Brush</u>	<u>Spray</u>
Below 50°F	Do not recoat	Do not recoat
50°F - 70°F	72 hr. - 48 hr.	36 hr. - 24 hr.
70°F - 90°F	48 hr. - 36 hr.	24 hr. - 16 hr.
90°F - 110°F	36 hr. - 24 hr.	16 hr. - 12 hr.

5.5 Application of CarboZinc 11 and Phenoline 305

Apply CarboZinc 11 and Phenoline 305 coatings in accordance with the manufacturer's recommendations.

6.0 WORKMANSHIP

All work shall meet the minimum requirements of this Specification and referenced standards or previously agreed upon variations of these standards.

All work shall be supervised by qualified persons who have read and understand the specific work he is responsible for supervising.

All work shall be done by persons experienced with the specific materials being applied or used unless accompanied by someone who is experienced in the work being performed.

Any completed work not meeting the minimum requirements of this Specification shall be corrected prior to the topcoating or completion of advanced stages of the operation.

7.0

INSPECTION

This is a high performance coating system specified for areas subject to severe exposure. Inspection should be implemented to ensure a quality coating system is applied.

Although the paint supervisor or his designee, experienced in the coating system being applied, should be responsible for inspecting all applications, random inspections should be performed by qualified inspection personnel.

All or any portion of finished work not meeting the minimum requirement of this Specification and referenced standards shall be corrected.

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