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SAN/0499-31  
MDC G8169

10 MWe Solar Thermal  
Central Receiver Pilot Plant

X TRU 137  
STMPD #143  
EXTRA Q.S.

SOLAR FACILITIES DESIGN INTEGRATION

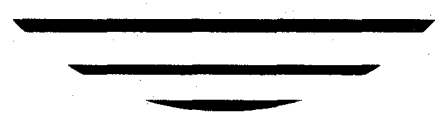
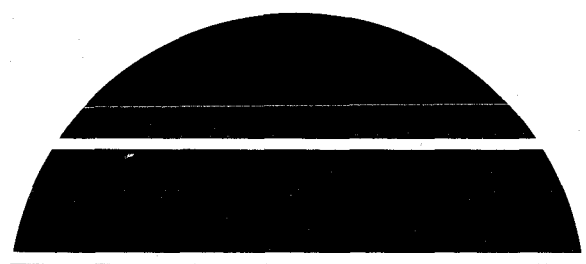
COLLECTOR FIELD FOUNDATIONS --

CONSTRUCTION PACKAGE NO. 6 (RADL ITEM 7-31)

November 1979

WORK PERFORMED UNDER CONTRACT  
DE-AC03-79SF10499

STEARNS-ROGER ENGINEERING CORP  
4500 CHERRY CREEK DRIVE  
P.O. BOX 5888  
DENVER, CO 80217



U.S. Department of Energy



Solar Energy

SAN/0499-31  
MDC G8169

**10 MWe Solar Thermal  
Central Receiver Pilot Plant  
Solar Facilities Design Integration**

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**COLLECTOR FIELD FOUNDATIONS --  
CONSTRUCTION PACKAGE NO. 6 (RADL ITEM 7-31)**

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**November 1979**

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**STEARNS-ROGER ENGINEERING CORP  
4500 CHERRY CREEK DRIVE  
P.O. BOX 5888  
DENVER, CO 80217**

**PREPARED FOR THE  
U.S. DEPARTMENT OF ENERGY  
SOLAR ENERGY  
UNDER CONTRACT DE-AC03-79SF10499**

## PREFACE

This technical construction package is provided by McDonnell Douglas Astronautics Company (MDAC) in accordance with Department of Energy Contract No. DE-AC-03-79SF10499, Reports and Deliverables List (RADL), Item 7-31. The report was prepared by Stearns-Roger Engineering Corporation under MDAC Subcontract No. 78012035.

This technical construction package will become Section 4 of the invitation for bid being prepared by the Department of Energy for the Collector Field Foundations Construction Package No. 6. This package defines the various foundation to be provided in the collector field which includes heliostat piers, BCS camera foundations, primary transformer pads, and a variety of foundations required for the weather forecasting equipment.

RADL 7-31 includes two parts, as follows:

- Technical Specifications for Construction Package No. 6, identified as STMPO Drawing No. 40C5001S (Stearns-Roger Project No. C-21700)
- Supplemental construction drawings as identified in Paragraph 2.1 of the Technical Specification

Questions concerning this report should be directed to R. J. Perkins at (714) 896-3073.

November 5, 1979

**TECHNICAL SPECIFICATIONS**

**NO. 40 C 500 - 1S**

for

**COLLECTOR SUBSYSTEM  
FOUNDATION CONSTRUCTION**

**CONSTRUCTION PACKAGE #6**

**Prepared by:**

**Stearns-Roger**  
ENGINEERING CORP.

**PROJECT NO. C-21700**

CONSTRUCTION PACKAGE NO. 6  
COLLECTOR SUBSYSTEM FOUNDATION CONSTRUCTION  
SECTION 4 - IFB

NOTICE

Wherever the term "Construction Manager" is used, it is intended that it shall mean the Contracting Officer's duly authorized representative which is Townsend and Bottum, Inc.

The Construction Manager will not direct the day-to-day operations of the Contractor, but will provide the inspection and verification of the Contractor's performance in accordance with the design specifications and drawings.

CONSTRUCTION PACKAGE NO. 6  
COLLECTOR SUBSYSTEM FOUNDATION CONSTRUCTION  
SECTION 4 - IFB

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COLLECTOR SUBSYSTEM FOUNDATION CONSTRUCTION  
SECTION 4 - IFB

LIST OF ABBREVIATIONS

The following abbreviations used in this Section 4 are defined as follows:

- ACI - American Concrete Institute
- AISC - American Institute of Steel Construction
- ASTM - American Society for Testing and Materials
- AWG - American Wire Gauge
- CRSI - Concrete Reinforcing Steel Institute
- IFB - Information for Bidders
- STMPO - Solar Ten Megawatt Project Office
- TOC - Top of concrete
- OD - Outside Diameter

CONSTRUCTION PACKAGE NO. 6  
SECTION 4 - IFB  
TECHNICAL INFORMATION

1.0 SCOPE OF WORK

The work of this Contract consists of collector subsystem foundation construction for the 10 MWe Solar Pilot Plant, near Daggett, California.

1.1 Description of Work

The work to be performed hereunder includes, but shall not necessarily be limited to the following:

1.1.1 Surveying and staking of work from existing reference points as necessary for accomplishing the Contractor's work.

1.1.2 Constructing heliostat foundation piers and wind tower foundation piers, complete with reinforcing and anchor bolts.

1.1.3 Constructing transformer pads and pads for miscellaneous electrical and electronic equipment, complete with reinforcing and embedded items.

1.1.4 Repairing and finish grading the areas disturbed by operations of this Contractor.

1.1.5 Drilling, excavating, filling, backfilling, compacting, grading, stockpiling, and other earthwork operations necessary for satisfactory completion of the above work.

1.1.6 Determining the actual installed pier bolt pattern locations and pier T.O.C. elevations, and preparing "As-Built" drawings.

1.1.7 Furnishing labor, supervision, materials, equipment, tools, templates, temporary facilities, supplies, and services not furnished by others, which are necessary for accomplishing the work of this Contract.

1.2. Work Not Included The following items of work will be performed by others:

1.2.1. Site preparation and initial grading.

1.2.2. Subsurface investigations



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TECHNICAL INFORMATION (CONTD)

1.2.3. Sampling, testing and inspection of soils, in-place compacted densities, concrete materials, and quality and specification compliance of delivered concrete, and hardened concrete.

1.2.4. Furnishing and installing collectors and equipment on the foundations constructed under this Contract.

1.2.5. Area dust control.

1.3. Collector Subsystem Foundation Alternate Designs. The Contract Drawings show two alternate designs for the Collector Subsystem Foundations (Alternates A and B). The Bidder shall submit a separate proposal for each design. The basic differences in the two designs are as shown on the Contract Drawings and include, but are not limited to, the number of heliostat and transformer foundations. The work included under these specifications shall consist of Collector Subsystem Foundation Construction in accordance with Alternate "A" or Alternate "B", but not both. The Contractor will be notified of the Alternate selected for construction.

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TECHNICAL INFORMATION (CONTD)

2.0 SUPPLEMENTS

The following Supplements are furnished with, and unless otherwise noted, form a part of this Specification:

2.1. Stearns-Roger Engineering Corp. Drawings

<u>Dwg. No.</u>	<u>S-R Dwg. No.</u>	<u>Sheet No.</u>	<u>Rev.</u>	<u>Title</u>
40C5005132701	XL-22934	C36-1	0	Collector Field Drilled Pier Foundations
40C5005132702	XL-22934	C36-2	0	Heliostat Foundation Location Table, Sht. 1
40C5005132703	XL-22934	C36-3	0	Heliostat Foundation Location Table, Sht. 2
40C5005132704	XL-22934	C36-4	0	Heliostat Foundation Location Table, Sht. 3
40C5005132705	XL-22934	C36-5	0	Heliostat Foundation Location Table, Sht. 5
40C5005132706	XL-22934	C36-6	0	Heliostat Foundation Location Table, Sht. 6
40C5005132707	XL-22934	C36-7	0	Heliostat Foundation Location Table, Sht. 7
40C5005132708	XL-22934	C36-8	0	Collector Field Miscellaneous Foundations
40C5005132709	XL-22934	C36-9	0	Collector Field Transformer Foundations
40C1005133900	XL-22934	G1-1	2	General Arrangement Plot Plan
40C1005133911	XL-22934	Y1-1	0	Site Plot Plan Layout
40C1005133912	XL-22934	Y1-2	0	Collector Field Plot Plan N.E. Quadrant
40C1005133913	XL-22934	Y1-3	0	Collector Field Plot Plan S.E. Quadrant
40C1005133914	XL-22934	Y1-4	0	Collector Field Plot Plan S.W. Quadrant
40C1005133915	XL-22934	Y1-5	0	Collector Field Plot Plan N.W. Quadrant
40C1005133921	XL-22934	Y2-1	0	Initial Grading Plan

2.2. Stearns-Roger Corporation Engineering Standards

<u>Standard No.</u>	<u>Title</u>
FC 20.01.9	Rod Bolt "RB" and Plate Washer, dated 4/4/77, 1 page.
FJ60.60,	Documentation Requirements, dated 7/16/79, 1 page.

2.3. STMPO Engineering Procedure. Department of Energy Engineering Procedure STMPO-A1, Rev. 0, titled "Document Identification," 6 pages.

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TECHNICAL INFORMATION (CONTD)

2.4. Geotechnical Report. The following Geotechnical Report is furnished for information only:

Woodward-Clyde Consultants, "Geotechnical Investigations for the Proposed Solar Pilot Plant, Barstow, California," dated July 27, 1978.

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TECHNICAL INFORMATION (CONTD)

3.0 CODES AND STANDARDS

3.1. The codes, standards and publications of the following organizations form a part of these Specifications to the extent indicated by the references thereto.

ACI - American Concrete Institute  
AISC - American Institute of Steel Construction  
ASTM - American Society for Testing and Materials  
CRSI - Concrete Reinforcing Steel Institute

Federal, State, County or Municipal Codes, Laws and Ordinances of the Place of Installation.

3.2. Should a conflict be found to exist between the listed codes and standards and this Specification, the conflict shall be submitted to the Construction Manager for resolution before proceeding with the affected work.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

4.0. DRAWING AND DATA SUBMITTALS

Prior to fabrication or delivery to the jobsite of the materials to be installed under this Contract, the Contractor shall submit to the Construction Manager for review and comment the drawings, mill test reports and descriptive data called for in the various Articles of this Section 4. Drawing and data submittal shall be in accordance with Article GC.14 of Section 3, GENERAL CONDITIONS, and Engineering Standard FJ60.60 attached. In addition, all documentation submitted shall bear identification in accordance with Paragraph 4.2 of STMPO-A1, "Document Identification," attached. Final discipline, system and block numbers will be furnished to the Contractor after receipt of his drawing list.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

5.0 EARTHWORK

This Article of these Specifications covers earthwork operations for the work of this Contract, excluding drilling for construction of drilled piers, which is specified separately under Article 6.0, DRILLED PIERS.

5.1. General Requirements

5.1.1. Lines and Grades. The work of this Contract shall be performed to the lines, grades and sections shown on the Drawings and specified herein.

5.1.2. Surveys and Layout of Work

5.1.2.1. The Contractor shall lay out his work from existing survey points established by others in the vicinity of the work area by setting additional survey points as necessary to establish and maintain control of the work.

5.1.2.2. It shall be the responsibility of the Contractor to maintain stakes and survey marks until their removal is authorized by the Construction Manager. If stakes and marks are removed, destroyed or concealed by the Contractor, or lost through his negligence prior to their authorized removal, they shall be restored by the Contractor at his expense.

5.1.3. Drainage Control and Dewatering. The Contractor shall maintain drainage in his various work areas to prevent collection of water in excavations, ponding, erosion, and excessively wet or unstable soil conditions. Operations shall include the following:

5.1.3.1. Grading in the vicinity of each excavation, including slopes, shall be controlled to prevent surface water from entering the excavation.

5.1.3.2. Water accumulating in excavations, from whatever source, shall be promptly removed by the Contractor. Dewatering operations shall be continued as necessary for maintaining suitable conditions in the excavations during filling and/or backfilling operations.

5.1.4. Weather Limitations. Earthwork operations involving compaction shall not be performed during periods when freezing temperatures, excessive moisture, or similar factors cause doubt that satisfactory results will be obtained.

5.1.5. Compaction Control

5.1.5.1. Moisture-density relations of soils will be determined in accordance with ASTM D1557, which will be referred to as control density hereinafter. Field in-place density tests of compacted fill, backfill and subgrade, will be performed in accordance with ASTM D1556, D2167 or ASTM D2922 nuclear method. Where in-place densities fall below the specified minimums, the Contractor will be required to rework those zones until the required densities are obtained.

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TECHNICAL INFORMATION (CONTD)

5.1.5.2. During placing and/or compacting operations with earth or earth-and-aggregate mixtures, the moisture content of material in the layer being compacted shall be near optimum (optimum + 1, -3 percent), and shall be uniform throughout the layer. The Contractor shall perform all operations necessary to ensure the proper moisture content, including sprinkling, scarifying, aeration or drainage.

5.1.6. Testing. Testing of materials to determine moisture-density relations, suitability of materials, and degree of compaction obtained will, except as follows, be performed at no cost to the Contractor, by a Testing Agency retained by the Construction Manager. The Contractor shall coordinate his work with the Construction Manager to permit inspection as the work progresses. In the event that tests show that rework is required, the Contractor shall perform the necessary rework at no additional compensation. Additional costs for testing necessary to verify that the rework is in compliance with the Specifications shall be borne by the Contractor.

5.1.7. Equipment. Should any equipment not be maintained in satisfactory working order or prove inadequate for obtaining the prescribed results, such equipment shall be repaired or replaced immediately upon notification to the Contractor that the work performed by the equipment is unacceptable and does not meet the requirements of the plans and Specifications.

5.1.8. Sheeting, Shoring and Bracing. It shall be the responsibility of the Contractor to provide and install sheeting, shoring, and bracing as necessary and as required by California and Federal safety regulations.

5.1.9. Stockpiling. When excess suitable materials result from the excavation work, or when excessive moisture in excavated material, construction procedure, or other factors make stockpiling of temporarily unsuitable materials advisable, the materials shall be placed in temporary stockpiles as approved by the Construction Manager. Different classes of materials shall be stockpiled separately. Stockpile areas shall be self-draining. Stockpile areas shall be prepared and maintained by the Contractor without additional compensation.

5.1.10. Wasting. Material which is to be wasted shall be wasted in the Disposal Area designated on Drawing Y1-1. Waste material shall be placed in the disposal area in such manner that the area will be self-draining. Compaction by at least two passes of a heavy roller will be required throughout the disposal area to prevent wind and rain erosion. Upon completion of wasting operations the Contractor shall rough grade and dress the area.

5.1.11. Construction Water. Raw water in the quantities required for the Contractor's use in earthwork operations will be available without charge at one location identified by the Construction Manager. The Contractor will be responsible for providing equipment for transporting and utilizing the water to meet his construction needs.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

5.2. Materials. Earthwork materials shall be obtained from excavation for structures or on-site stockpiles approved by the Construction Manager.

5.2.1. Suitable Materials. Earthwork materials, to be considered as suitable for use in the work, shall be free from objectionable materials such as perishable matter, trash, debris, frost or frozen materials, stones and hard cemented pieces larger than 3 inches, and shall be compactible, either with or without blending, to the required densities. In addition, all material placed within 18 inches of finished grade shall swell less than 3 percent when tested in accordance with Uniform Building Code Test Method 29-2.

5.2.2. Unsuitable Material

5.2.2.1. Material containing perishable matter such as roots, sod, grass, decayed vegetable matter, debris, frost or frozen material, or materials which cannot be compacted to the specified densities, shall be classified as unsuitable for use in the work.

5.2.2.2. Materials which are temporarily unsuitable due to frost, excessive moisture or improper gradation will not be classified as unsuitable if such material can be satisfactorily reclaimed by screening, aerating, or blending.

5.2.2.3. Temporarily unsuitable materials shall be stockpiled in accordance with Paragraph 5.1.9., "Stockpiling." Permanently unsuitable materials shall be wasted in accordance with Paragraph 5.1.10., "Wasting."

5.3. Excavation

5.3.1. General

5.3.1.1. Excavation shall consist of the removal and disposition of all materials encountered, regardless of their nature, to the lines, grades and dimensions shown on the drawings and specified herein.

5.3.1.2. All excess material excavated and not used for subsequent backfill per paragraph 5.5 or in restoring finish grades per paragraph 5.6 shall be wasted in accordance with paragraph 5.1.10.

5.3.2. Classification of Excavation. All excavation shall be classified as common excavation. It is not anticipated that hard, cemented materials will be encountered in the work.

5.4. Excavating for Miscellaneous Foundations. Excavation for pads, slabs on grade and other miscellaneous shallow foundations, excluding drilled piers, shall be made to the limits and elevations indicated in compacted natural earth or compacted structural fill, as applicable. Excavation shall extend a sufficient distance from pad and slab perimeters to allow for placing and removal of forms, and for inspection, patching and finishing of concrete. Undercutting will not be permitted. Except as specified, overexcavation shall be avoided.



SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

5.4.1. Directed Overexcavation. If, when the indicated limits of excavation are reached, the exposed material is found to have unsuitable qualities, the Construction Manager will direct, in writing, the corrective measures to be taken and an equitable adjustment in price will be made for this additional work in accordance with the provisions of the Contract.

5.4.2. Unauthorized Overexcavation. Unauthorized overexcavation and the corrective measures necessitated thereby will not be considered as a basis for claims for additional payment.

5.4.3. Correcting Overexcavation Beneath Foundation Locations. Should overexcavation occur or be directed beneath the required bottom-of-concrete elevations for other than drilled piers, the Contractor shall perform corrective measures in accordance with the following requirements. Loose or disturbed material shall be compacted or removed and backfilled to the required elevation with structural fill placed at near optimum moisture content, in horizontal layers not exceeding 8 inches in uncompacted thickness. Each layer shall be uniformly compacted to 90 percent of control density before placing the succeeding layer. Finished elevations of backfill beneath structures shall be within 0.2 foot of the elevation shown. Lean concrete may be used in place of structural fill.

5.5. Backfilling Foundations. Material for backfilling foundations shall meet the requirements specified for suitable material. Backfill shall be placed symmetrically to prevent eccentric loading on the foundation and brought up to finish grade elevations shown on the Drawings. Backfill shall be placed at near optimum moisture content in horizontal layers not exceeding 8 inches in uncompacted thickness when machine compacted, and not more than 6 inches when hand compacted. Layers shall be compacted to at least 90 percent of control density before placing succeeding layers.

5.6. Restoration of Finish Grades. The Contractor shall restore finish grades wherever disturbed by his construction, storage, equipment movement or other operations under this Contract, and shall leave those areas finish graded, compacted to the applicable densities, and at the elevations indicated on the Drawings.

5.6.1. The above operations shall include placing and compacting additional suitable materials if necessary.

5.6.2. The degree of compaction required is 90 percent of control density throughout the Collector Field, 95 percent of control density for roads and traffic areas, and 90 percent of control density for other areas.

5.6.3. The finish graded areas shall be smooth, compacted to the specified density, and free from irregular areas and areas which would pond water. The degree of finish required shall be that ordinarily obtainable from either blade grader or scraper operations. The finished and graded surfaces shall be not more than 0.1 foot above or below the indicated grade or cross-section.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

6.0 DRILLED PIERS

This Article covers constructing drilled foundation piers for heliostats (collectors) and Wind Towers of the Collector Field.

6.1. General

6.1.1. The Contractor shall furnish, deliver and install materials required for constructing the drilled piers.

6.1.2. Concrete for concreting of drilled piers, and scheduling of concrete deliveries to meet the Contractor's construction needs, shall conform to Article 8.0, CONCRETE WORK, of these Specifications.

6.2. Materials

6.2.1. Reinforcing

6.2.1.1. Vertical reinforcing bars shall be new, deformed billet steel bars conforming to ASTM A615, Grade 60. Sizes for the various uses shall be as shown on the Drawings.

6.2.1.2. Spiral reinforcing steel shall be cold-drawn steel wire conforming to ASTM A82.

6.2.1.3. Spiral spacers in accordance with ACI 315 shall be furnished by the Contractor for assembly of the reinforcing cages.

6.2.1.4. Banding rings shall be of steel conforming to ASTM A36 fabricated to the sizes shown on the drawings.

6.2.2. Concrete. Concrete for drilled piers shall be Class CS conforming to Article 8.0, CONCRETE WORK, having a maximum aggregate size of 3/4-inch.

6.2.3. Bonding Grout. Bonding grout shall consist of 3 parts sand to 1 part Portland cement, with enough water to produce a thick, flowable mix.

6.2.4. Molded Fiber Concrete Forms. Cylindrical forms for forming the tops of drilled piers shall be "A-Coated Sonotube" cylindrical molded fiber concrete forms, or Construction Manager approved equal. Form diameter shall be as shown on the drawings, and the wall thickness shall be the manufacturer's standard for the tube diameter.

6.2.5. Embedded Items. Anchor bolts, grounding, conduit, and other embedded items shall be as shown on the Drawings and specified in Article 7.0 EMBEDDED ITEMS.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

6.3 Equipment. Equipment used in the work shall be of a suitable type, design and capacity and shall be maintained in safe and satisfactory condition. Any equipment not maintained in satisfactory working order or that proves inadequate for obtaining the required results, shall be repaired or replaced immediately upon notification to the Contractor that the work performed by the equipment is unacceptable.

6.3.1. Drilling Equipment. Holes for drilled piers shall be drilled with a power auger of a suitable type and capacity acceptable to the Construction Manager.

6.3.2. Temporary Casings. Temporary casings shall be smooth steel cylinders having an outside diameter approximately the diameter of the drilled hole, and having a wall thickness not less than 1/180th of the outside diameter of the casing, except that no casing need be thicker than 5/16 inch.

6.4. Drilling and Associated Work

6.4.1. Drilling Procedure

6.4.1.1. Pier holes shall be drilled to at least the penetration indicated on the Drawings.

6.4.1.2. Pier center locations shall be determined with the required degree of accuracy and staked by the Contractor. The Contractor shall also set reference stakes for each hole so that pier hole location can be rechecked during drilling.

6.4.1.3. Each hole shall be located, started and drilled such that the completed hole will be within the following tolerances:

Correct location in plan at top of pier:	3 inches in any direction from the location tabulated on the drawings.
Plumbness (maximum allowable deviation per foot of depth):	0.25 inch

6.4.1.4. Should it be determined by the Construction Manager that a hole drilled to the listed penetration has not adequately penetrated suitable material, it will be directed that the hole be drilled deeper. Such directed overdepths beyond the indicated bottom-of-hole elevations will be a basis for additional compensation. Unauthorized overdepths, and the resulting increase in concrete and reinforcement, will be at the expense of the Contractor.

6.4.2. Use of Temporary Casing. After drilling, if required to prevent caving, a temporary casing shall be installed in each hole. The temporary casing shall remain in-place until placement of concrete, at which time the casing shall be slowly withdrawn as the concrete is placed, maintaining the bottom of the casing approximately two feet below the top of the fresh concrete as the pour progresses.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

6.4.3. Clean-Out

6.4.3.1. After completion of drilling each hole shall be cleared of all loose material. Each drilled hole shall be protected against entry of water or loose material and shall be kept covered until filled with concrete, unless clean-out, inspection or other work is in progress in the hole.

6.4.3.2. Just prior to concrete placement, each hole shall be free from loose material and standing water. Concrete shall be placed as soon as possible following approval of each drilled hole. The Contractor shall schedule his operations such that drilled holes are filled with concrete the day they are excavated.

6.4.3.3. If a completed pier hole is allowed to stand empty overnight, it shall be reinspected, and re-cleaned if necessary, just prior to placing the concrete.

6.4.3.4. If the Contractor permits accumulation of water in a drilled hole, the Contractor shall reposition the drilling equipment, remove all loose debris from the hole and drill one (1) foot deeper. The repositioning of the equipment, labor, additional concrete and the additional reinforcing steel, shall be at the expense of the Contractor.

6.4.4. Disposal of Cuttings. The Contractor shall satisfactorily dispose of excess excavated materials resulting from the construction of drilled piers. At the option of the Contractor, he shall either waste the excess material in accordance with Paragraph 5.1.10., or shall distribute the excess excavated material throughout the Collector Field, then compact and grade the Collector Field in accordance with Paragraph 5.6.3.

6.5. Inspection. Pier holes will be inspected by a designated representative of the Construction Manager for tolerances and clean-out before placement of reinforcing. The Contractor shall notify the Construction Manager a minimum of one hour in advance of the time when an inspection will be required. The Contractor shall have verified the readiness of the hole by an inspection performed by his own personnel and shall provide safe and adequate equipment and full cooperation to the inspecting personnel.

6.5.1. Out-of-Tolerance Holes. When, upon inspection, the location or alignment of a drilled hole is found to exceed tolerance limits, the Construction Manager will inform the Contractor of the measures to be taken in correcting or compensating for the defect to make the finished pier acceptable. Dependent upon the nature and severity of the defect or defects, one or a combination of the following measures may be required:

6.5.1.1. An increase in total reinforcement in the pier.

6.5.1.2. Reaming the hole to a larger diameter.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

6.6. Reinforcing

6.6.1. General

6.6.1.1. All indicated reinforcing, and all additional reinforcing which may be required due to overdepths, shall be furnished, assembled and placed by the Contractor.

6.6.1.2. Stiffeners, spiral spacers, banding rings and bracing necessary for handling and installation of the cages shall be furnished and installed by the Contractor.

6.6.1.3. The reinforcing cages shall be assembled and placed by the Contractor to the elevations shown on the Drawings.

6.6.2. Assembling

6.6.2.1. Except as otherwise specifically approved in writing by the Construction Manager, each reinforcing cage shall be assembled above ground, inspected, and then placed in its inspected and approved hole.

6.6.2.2. Details of reinforcement for each diameter pier, including cage OD; size, type and arrangement of bars; splice locations and minimum allowable lap for splices in each size bar, shall be as shown on the Drawings. Reinforcing details not otherwise defined shall be in accordance with ACI 318.

6.6.2.3. Splices in adjacent bars shall be staggered as shown on the Drawings. Splices shall be wire tied.

6.6.2.4. Reinforcing steel may be cut by shearing, sawing or flame cutting. The use of heat to bend or straighten reinforcing steel will not be permitted. Reinforcing steel reduced in section shall not be used.

6.6.2.5. Welding of cage assemblies will not be permitted except at unstressed ends of vertical bars.

6.6.2.6. Where spirals are used, spiral spacers shall be made from bar stock of appropriate cross section and shall be securely wired to the cage steel.

6.6.3. Inspection. After assembly and before placement in the drilled hole, each reinforcing cage will be inspected for compliance with the drawings and for satisfactory assembly. Under no circumstance shall a cage be placed before inspection and approval. The Contractor shall correct any defects to the satisfaction of the inspector.

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TECHNICAL INFORMATION (CONTD)

6.6.4. Placement

6.6.4.1. Before being placed, the reinforcing steel shall be thoroughly cleaned of loose or flaky rust, mill scale, mud or other substances, including ice or frost, which would reduce or destroy the bond with the concrete.

6.6.4.2. Care shall be taken to prevent deformation of the fabricated reinforcing cage or dislodgement of soil as the cage is installed. Sidewall or surface material knocked into holes during lowering operations shall be promptly removed by the Contractor.

6.7. Concrete Placement

6.7.1. Preparation for Concrete Placement. Concrete placement shall not be commenced until approval for placement is given by the Construction Manager. Approval for concreting will not be given until the following requirements are met:

6.7.1.1. The hole is free from standing water and loose materials.

6.7.1.2. Approved reinforcing is in place and properly positioned.

6.7.2. Placing Concrete

6.7.2.1. Except as otherwise specified, placing of concrete shall conform to Chapter 5 of ACI 318. Concrete which has attained initial set or which has contained its mixing water for more than 90 minutes (45 minutes during hot weather) shall not be placed in the work and shall be wasted. Concrete slump shall be 5 inches ± one inch.

6.7.2.2. Once begun, concrete placement for each drilled pier shall be carried through to completion at a rate and with a continuity that avoids cold joints. If, in the placing of concrete, an exposed lift of concrete in an uncompleted pier attains initial set, the surface shall be cleaned of laitance and covered with approximately one (1) inch of bonding grout immediately before resuming concreting.

6.7.2.3. Concrete shall be placed with tremies, by pumping, or other approved methods which will prevent segregation of ingredients.

6.7.2.4. Care shall be exercised throughout concrete placing to prevent displacing of reinforcing and to maintain at least minimum concrete coverage between reinforcing and walls of drilled holes.

6.7.2.5. Concrete shall be placed in lifts not exceeding four (4) feet in depth. As the lifts of each drilled pier are placed, they shall be vibrated. The Contractor shall exercise caution to prevent vibrators contacting reinforcing, nor shall they be lowered into underlying courses which have begun to set.

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6.7.2.6. Concrete shall be consolidated by the use of high-frequency internal vibrators. The type and operation of vibrators shall be subject to the Construction Manager's approval. Consolidation procedure shall conform generally to ACI 614 and to the following:

6.7.2.6.1. Vibration shall be applied along the pier axis throughout the freshly placed concrete.

6.7.2.6.2. Vibration shall be such as to secure the desired results within 5 to 15 seconds at closer spaced points, rather than for longer periods at wider intervals. To prevent segregation of the mix, vibration shall be continued only long enough to accomplish thorough consolidation and complete embedment of the reinforcement.

6.8. Forming Pier Tops. The top of each pier, from the indicated top-of-concrete (TOC) elevation downward for a distance of not less than 1 foot, shall be accurately formed, concentric with the axis of the pier, vertical, cylindrical in section, with a smooth finish.

6.8.1. Forming shall be accomplished by the use of the specified molded fiber tube forms of the nominal diameter shown on the drawings.

6.8.2. Forms shall be accurately positioned, shall be protected against displacement during concreting, and shall remain in place for the full curing period.

6.9. Anchor Bolts. The anchor bolt pattern required in each pier top, and its orientation, is shown on the Drawings and specified in Article 7.0, EMBEDDED ITEMS.

6.10. Top of Concrete. The top of concrete of each pier shall be given a wood float finish and shall meet the following requirements after finishing. The top of concrete of each pier shall be at the elevation tabulated on the drawings within a tolerance of  $\pm 0.10$  foot, and the concrete surface shall be horizontal within  $\pm 1/8$ -inch.

6.11. Pier Marking. Each heliostat foundation pier shall be marked with the appropriate heliostat number (first 4 digits). Space shall be left for two (2) additional characters to be added in the future. The numerals shall be 1/2 inch minimum in size and shall be stamped on a 16 gage minimum stainless steel or brass tag which shall be wired to an anchor bolt of each pier.

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7.0 EMBEDDED ITEMS

This Article of these Specifications covers steel items, other than reinforcement, to be embedded in the concrete work of this Contract.

7.1. General

7.1.1. The Contractor shall furnish and install all items to be embedded in concrete construction installed under this Contract. The embedded steel items shall conform to the Drawings, attached Engineering Standards, and the requirements specified herein.

7.1.2. The following Engineering Standard is included with, and forms a part of this Article 7.0, EMBEDDED ITEMS.

<u>Standard No.</u>	<u>Date</u>
FC 20.01.9	4/4/77

7.2. Materials

7.2.1. Anchor Bolts. Anchor bolts shall be fabricated in the shop. Anchor bolts shall be of the sizes, configuration and dimensions indicated on the Drawings and Engineering Standards.

7.2.1.1. Bar, rod and plate for anchor bolts shall be steel conforming to ASTM A36. The Contractor shall submit mill test reports for anchor bolt material furnished hereunder, in accordance with Article 4.0, DRAWING AND DATA SUBMITTALS.

7.2.1.2. Anchor bolts and their nuts shall be hot-dip zinc coated (galvanized) in accordance with ASTM A153. Galvanizing shall be performed only after all threading, welding and other fabricating operations have been completed on them.

7.2.1.3. To permit engagement and proper fit after galvanizing, the threads of the nuts and bolts shall have excess zinc removed by being cleaned (chased) with a tap or die, as applicable, before shipment to the jobsite.

7.2.1.4. Anchor bolts for heliostat foundations shall have three (3) galvanized heavy pattern hex nuts, two (2) plain washers, and one (1) plate washer as indicated on the drawings.

7.2.2. Conduit. Conduit to be embedded in concrete shall be standard weight rigid steel conduit. The size for each use shall be as indicated on the Drawings. The conduit shall be provided with a bonded PVC jacket or with an approved corrosion protection for the conditions of installation. Conduit shall have a protective coating of enamel or lacquer applied to the inside of the conduit. Each length of conduit shall be fitted with a coupling or bushing as indicated on the drawings and each and shall be reamed to remove burrs and sharp edges.



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7.2.3. Conduit Fittings. Conduits embedded in concrete shall have ends closed and plugged as shown on Drawing Sheet No. C36-9. Conduit fittings for this use shall be as follows, or Construction Manager approved equal:

7.2.3.1. Plastic insulating pop-on bushings shall be Thomas & Betts Catalog No. TRIB-400.

7.2.3.2. Plugs for underground use shall be plastic, Thomas & Betts Catalog No. 1479. Plugs for above ground use shall be Crouse-Hinds Type PLG.

7.2.4. Hail Cube Supports. Hail cube supports shall be welded assemblies as shown on the Drawings, fabricated from Schedule 40 steel pipe conforming to ASTM A53, and ASTM A36 steel plate. Each support shall be hot-dip galvanized after fabrication.

7.3. Heliostat Foundation Anchor Bolt Templates. An accurately located and oriented 24-inch diameter circle of eight (8) equally spaced anchor bolts of the size indicated shall be installed in the top of each heliostat foundation pier as detailed on the Drawings and as specified herein. Accuracy is of the utmost importance in the setting of these anchor bolt groups, and the tolerances specified are the maximum allowable. The use of Contractor-furnished close-tolerance templates meeting the following requirements is mandatory in meeting the required accuracy of each bolt group. Shop drawings of the Contractor's proposed template design shall be submitted to the Construction Manager for approval prior to fabrication.

7.3.1. Each template shall be a rigid steel plate or ring of design and construction meeting the following tolerances. The template may be a combination template and jig capable of retaining the anchor bolts in fixed position in the template until released.

7.3.2. Each template bolt circle shall consist of eight (8) equally spaced holes for 1-1/4 inch bolts, with their centers located on a 12-inch radius circle. Radius tolerance shall be  $\pm 1/32$ -inch.

7.3.3. The bolt holes shall be equally spaced at 45 degree increments on the bolt circle, each located within a tolerance of  $\pm 0.15$  degree.

7.3.4. Each template shall be capable of maintaining the bolts in alignment at 90 degrees  $\pm 0.20$  degree to the plane of the template.

7.4. Setting Heliostat Foundation Anchor Bolts. In addition to the preceding anchor bolt accuracy which must be established and maintained by each template, the following tolerances shall be established and maintained in setting each bolt group in its foundation pier.

7.4.1. Each circle of anchor bolts shall be centered upon the location tabulated on the drawings within  $\pm 3$  inches and upon the vertical axis of its pier within  $\pm 2$  inches.

7.4.2. Each bolt circle shall be oriented and set with two diametrically opposite bolts oriented in true north-south alignment within  $\pm 5$  degrees.

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7.4.3. All bolts in each group shall be vertical within  $\pm 0.20$  degree.

7.4.4. The tops of all bolts in each group shall be in the same horizontal plane  $+ 1/8$ -inch, and each bolt group shall project  $5-3/4$  inches  $\pm 1/4$ -inch above the concrete.

7.4.5. The Contractor shall mechanically connect a #2 AWG bare copper wire to the north anchor bolt of each group, and to a vertical reinforcing bar of that pier, in accordance with the Drawings. The copper wire shall emerge from the top of concrete near the center of the pier. The wire shall extend 4 feet above the concrete surface and shall be coiled.

7.4.6. After setting an anchor bolt group to the required accuracy, the bolts and template shall be protected from displacement and the template shall not be removed until the concrete of the pier top has attained an age of at least 18 hours. All exposed threads shall then be wire brushed to remove all traces of concrete.

7.5. Anchor Bolts for Other Than Heliostat Foundations. Anchor bolts for other than collector foundation piers shall be set to the accuracy which will be required by the future equipment, as dimensioned on the Drawings.

7.6. Embedded Conduit. Electrical conduit to be embedded in concrete shall be of the size and configuration indicated for the particular use. Conduit shall be free from flattening, dents, and bends not indicated on the Drawings.

7.6.1. The conduit shall be watertight and shall have ends sealed against entry of concrete and other foreign material, as indicated on the drawings, before being placed in the forms.

7.6.2. The conduit shall be accurately positioned in the forms and shall be protected against displacement during concrete placement and finishing operations.

7.7. Hail Cube Supports. The Hail Cube supports shall be installed where shown on the Drawings, embedded in concrete to not less than the depth indicated, with the top plate of each support horizontal within  $1/16$ -inch.

7.8. "As-Built" Survey of Foundations

7.8.1. Following their construction, the heliostat foundations and camera foundations shall be surveyed by a licensed Land Surveyor or Registered Civil Engineer retained by the Contractor to determine actual location and elevation of each. The coordinates of the center of each heliostat and camera foundation's anchor bolt circle shall be determined within 0.05 foot in plan, and the actual elevation of the top-of-concrete (TOC) shall be determined within  $\pm 0.02$  foot.

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7.8.2. The Contractor shall record and enter the actual "As Built" locations and elevations, determined in accordance with the preceding paragraph, in the "As Built" spaces provided on Drawings C36-2 through C36-8. Two (2) copies of these "As Built" Drawings shall be prepared, certified by a licensed Land Surveyor or Registered Civil Engineer, and furnished to the Construction Manager prior to completion of Contract.

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8.0 CONCRETE WORK

This Article of these Specifications shall govern all concrete work of this Contract. Additional requirements applicable to Drilled Piers are included in Article 6.0, DRILLED PIERS.

8.1. General

8.1.1. Concrete Supply. The Contractor shall arrange for his own concrete supply, and shall be responsible for his concrete supply meeting specified requirements, including, but not limited to, strength requirements, cement type and content, aggregate sizes and slump.

8.1.2. Sampling and Testing. Sampling and testing to determine suitability and specification compliance of concrete materials, concrete at point of placement, and hardened in-place concrete, will be performed by a Testing Agency retained by the Construction Manager as specified in Paragraph 8.5., Sampling, Testing, and Control.

8.1.3. Scheduling. The Contractor shall be solely responsible for scheduling with his concrete supplier for the class or classes of concrete needed, and the start, duration and rate of concrete deliveries necessary to meet the Contractor's construction needs.

8.1.4. Design Mixes. The Contractor shall furnish the Construction Manager three (3) copies of his concrete supplier's design mix applicable to each class of concrete to be furnished. Following submittal of design mixes, the sources of materials, type of cement, and mix proportions shall not be changed without the Construction Manager's prior approval. With the design mixes, the Contractor shall submit certification from an approved testing laboratory that (1) the aggregate which will be used in the concrete for the work of this Contract will not create an alkali-aggregate reaction and (2) that the mix will produce the concrete strength specified. Such certification shall be based upon chemical testing, petrographic analysis of aggregate samples, or other methods acceptable to the Construction Manager.

8.1.5. Classes of Concrete and Usage. The classes of concrete which will be required in the work of this Contract are specified hereinafter. Usage of the various classes of concrete in the work shall be as shown on the Drawings.

8.2. Materials Other Than Concrete

8.2.1. Admixtures. Admixtures, when required, shall conform to the following:

8.2.1.1. Air-Entraining Admixture: ASTM C260.

8.2.1.2. Water-Reducing Admixture: ASTM C494 Type A.

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8.2.1.3. Set-Retarding Admixture: ASTM C494 Type B.

8.2.2. Reinforcing

8.2.2.1. Bars. Reinforcing bars shall be new deformed billet steel bars conforming to ASTM A615 Grade 60, except for ties and stirrups which shall conform to ASTM A615 Grade 40 or Grade 60.

8.2.2.2. Mesh. Reinforcing mesh shall be welded wire fabric conforming to ASTM A185, mesh and gage as called for on the Drawings.

8.2.3. Reinforcement Accessories. Reinforcement accessories shall be free from flake rust, scale, grease, clay, and other coatings or foreign substances which would reduce the bonding qualities. Materials shall be as follows:

8.2.3.1. Tie Wire. Tie wire shall be annealed wire, not less than No. 16 gage, of suitable quality for securing reinforcement in place.

8.2.3.2. Bar Supports. Supports shall be standard bright basic wire sufficiently heavy to properly carry the steel they support, or shall be precast concrete blocks. Wire pieces and number of supports shall conform to specifications for placing accessories as published by the Concrete Reinforcing Steel Institute.

8.2.4. Forms. Material for form work shall consist of wood, metal or other approved material, free from objectionable surface defects which might affect the finished concrete. The type of material is optional with the Contractor unless specific requirements are indicated on the Drawings. All contact forms for exposed surfaces shall be plywood, metal or other approved smooth surface material.

8.2.4.1 Internal form ties shall be factory-fabricated removable or snap-off ties of approved design, fixed or adjustable in length, and shall be free from devices that will leave a hole larger than 1 inch in diameter in the surface of the concrete. The portion of the tie remaining in the concrete after the removal of the exterior parts shall not project beyond the surface of the concrete and shall be at least 1 inch back from any surface that will be exposed to view in the finished work. Internal ties fabricated at the jobsite shall not be used.

8.2.5. Embedded Items. Inserts, anchor bolts, weld plates, leveling channels, clips and other devices for embedment concrete shall be of standard manufacture, and of the types detailed, specified, or otherwise required to satisfactorily engage and anchor the work.

8.2.6. Expansion Joint Materials. Materials for expansion joints shall meet the following requirements:

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8.2.6.1. Expansion Joint Fillers: Preformed resilient nonbituminous type conforming to ASTM D1752, Type I.

8.2.6.2. Sealing Compound: Hot-poured elastic type conforming to ASTM D1190.

8.2.6.3. Calking Compound: An approved commercial two-component polysulfide base calking compound. Gun-grade shall be used for vertical joints.

8.2.6.4. Primer: As recommended by the manufacturer of the calking compound.

8.2.6.5. Backing Rod: Round, preformed foamed polyurethane rod having a diameter not less than 1-1/2 times the width of the joint in which it is to be installed.

8.2.7. Form Oil. Form oil shall be a commercial form oil of satisfactory and proven performance that will prevent adhesion of the concrete to the forms, but will not penetrate, stain or adversely affect concrete surfaces. It shall not impede wetting of surfaces to be damp cured, nor impair subsequent surface treatments which depend upon bond or adhesion.

8.2.8. Curing Materials. Curing materials shall meet the following requirements, as applicable:

8.2.8.1. Waterproof Paper: ASTM Standard C171, regular or white.

8.2.8.2. Mats: Commercial curing mats of cloth or canvas.

8.2.8.3. Burlap: Commercial Standard.

8.2.8.4. Membrane-Forming Curing Compound: ASTM Standard C309, Type 1 or ID Class B. Wax base or wax-resin base curing compounds will not be permitted.

8.2.8.5. Polyethylene Sheeting: ASTM C171.

8.2.8.6. Polyethylene-Coated Burlap: ASTM C171.

8.2.9. Embedded Items. Embedded anchor bolts and conduit shall be as specified in Article 6.0, EMBEDDED ITEMS.

8.3. Concrete Requirements

8.3.1. Concrete. Concrete shall be batched, mixed and delivered in accordance with ASTM C94, "Ready-Mixed Concrete", Alternative 2, as further defined below, and with this Specification:

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8.3.1.1. Aggregate shall conform to ASTM C33. Coarse aggregate shall be of two sizes: No. 4 (1-1/2 inches to 3/4 inch) and No. 67 (3/4 inch to No. 4 sieve).

8.3.1.2. Cement shall be an approved brand of Portland cement conforming to ASTM C150 Type II, low-alkali. A single brand of cement shall be used throughout the work.

8.3.1.3. Water shall conform to the requirements of Paragraph 4.1.3 of ASTM C94.

8.3.2. Class and Strength. The following classes and strengths of concrete will be required in the work:

<u>Class*</u>	<u>Max. Aggregate Size (Inches)</u>	<u>Minimum Allowable Compressive Strength at 28 days (psi)</u>
CL	1-1/2	3000
CS	3/4	3000

8.3.3. Usage. Usage of the various classes of concrete in the work shall be as indicated on the Drawings.

8.3.4. Air Entrainment. Concrete which will remain exposed to the weather in the finished work shall contain an air entraining admixture which produces concrete containing the following air content at the point of discharge from the transport vehicle:

<u>Maximum Aggregate Size (Inches)</u>	<u>Total Air Content (Percentage by Volume)</u>
1-1/2	4 to 6
3/4	5 to 7

8.3.5. Water Reducing Admixture. A water reducing admixture may be used in both Classes CL and CS concrete. Usage shall be in accordance with the recommendations of the manufacturer of the admixture.

8.3.6. Set-Retarding Admixture. Set-retarding admixture shall be used in concrete for this Contract only when requested by the Contractor and approved for the particular use, in writing, by the Contracting Officer.

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\*An "A" suffix following the above class designations shall indicate air entrainment is required. Such suffix shall, when applicable, be part of the class designation in orders for concrete issued by the Contractor.

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8.3.7. Slump. At the point of discharge from the transport vehicle, the concrete shall have slumps within the following limits:

<u>Types of Construction</u>	<u>Slump in Inches</u>	
	<u>Maximum</u>	<u>Minimum</u>
Reinforced footings and small mat foundations:	4	2
Reinforced slabs:	4	2
Slabs on ground:	4	2
Drilled piers:	6	4

8.4. Mixing and Delivery. Truck mixers shall conform to the applicable requirements of ASTM C94.

8.4.1. Cold Weather Concreting. Concrete mixed and delivered when the mean ambient temperature is 40 degrees F or less shall be mixed and delivered in accordance with the American Concrete Institute Standard ACI 306 "Recommended Practice for Cold Weather Concreting."

8.4.2. Hot Weather Concreting. Concrete mixed and delivered when the mean ambient temperature (as defined in ACI 301, Section 8.4.3) would be detrimental to concrete, shall be mixed and delivered in accordance with the American Concrete Institute Standard ACI 305 "Recommended Practice for Hot-Weather Concreting." Concrete temperatures at time of discharge from the truck shall not exceed 90 degrees F.

8.4.3. Contractor Responsibility. The Contractor shall bear complete responsibility for the delivery of satisfactory concrete conforming to the requirements of this Specification. The Contractor shall effect such alterations in methods and equipment, and furnish new materials and concrete as may be required, when tests indicate that materials or concrete as delivered, did not meet Specification requirements.

8.4.4. Delivery Tickets

8.4.4.1. Each load of concrete shall be accompanied by a delivery ticket, in triplicate. After the concrete has been discharged or the truck has been released, one copy of each waybill shall be grouped with other waybills for that pour, and shall be delivered to the Construction Manager within 24 hours.

8.4.4.2. Each waybill shall show the information prescribed by Article 15.1 of ASTM C94, and in addition, shall show the information listed under Article 15.2 of ASTM C94.

8.4.5. Allowable Time Interval Between Mixing and Placing. Concrete shall be placed in the forms within forty-five (45) minutes after the addition of water to the cement and aggregate when hot weather conditions prevail. At



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other times, the time limit shall be ninety (90) minutes. Discharge of the concrete shall be completed within the time limits specified above, and then only if the initial set has not been attained in the concrete.

8.5. Sampling, Testing and Control

8.5.1. Testing Agency

8.5.1.1. Throughout this Contract, testing necessary to verify suitability of materials, determine quality of delivered concrete, and making control cylinders, may be performed by the Testing Agency retained by the Construction Manager.

8.5.1.2. The Contractor shall permit these Testing Agency personnel unrestricted access to delivered or stored materials, batching and mixing facilities, and transport equipment, and shall provide such cooperation and assistance as may be requested by them.

8.5.1.3. The Construction Manager will notify the Contractor prior to placement, of any concrete having excessive slump, or otherwise not meeting Specification requirements. The Contractor shall be solely responsible for any materials used in the work that do not comply with the Specifications.

8.5.2. Sampling and Test Methods

8.5.2.1. Slump Testing. Slump testing of delivered concrete will be in accordance with ASTM C143.

8.5.2.2. Strength Tests During the Work. Two sets of three cylinders for test purposes will be taken from each 100 cubic yards or fraction thereof, or each day's pour, whichever is less, of the concrete placed. Test specimens will be made and cured in accordance with ASTM C31. Cylinders will be tested in accordance with ASTM C39. One set of three cylinders will be tested at 7 days and the second set at 28 days. If the average of the strength tests of the specimens cured for 7 days under laboratory controls for any portion of the work falls below 70 percent of the minimum allowable compressive strength of 28 days required for the class of concrete used in that portion, the Contractor will be notified by the Construction Manager.

8.5.2.3. Tests of Hardened Concrete In, or Removed From Structures. Where the results of the strength tests of the control specimens indicate the concrete as placed does not meet Specification requirements, or where there is other evidence that the quality of the concrete is below Specification requirements, coring and testing conforming to ASTM C42 will be performed. Where the test results indicate that the in-place concrete does not meet Specification requirements, the cost of the tests and such corrective measures as may be prescribed, including additional curing and/or removal and replacement of the defective work, shall be borne by the Contractor. If the tests indicate that the concrete as placed meets Specification requirements, the costs of the tests will be borne by the Contracting Officer.

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8.5.2.4. Tests for Uniformity of Concrete. The Construction Manager may, as deemed necessary, require tests for uniformity of concrete in accordance with the applicable requirements of ASTM C94.

8.6. Form Installation.

8.6.1. General. Forms, complete with appurtenances, shall be constructed to conform to shape, form, line and required grade. The forms shall be maintained sufficiently rigid to prevent deformation under load in order that deflection under the weight of wet concrete will not exceed 1/8-inch. Studs shall be closely spaced to prevent deflection of form material and consequent waviness in the surface of the concrete.

8.6.2. Responsibility. The Contractor shall be responsible for design, adequacy, and safety of formwork, the design of which is subject to the Construction Manager's review. Completed forms, in place, must be inspected by the Construction Manager prior to concrete placement. Formwork design shall conform to ACI 347, "Recommended Practice for Concrete Formwork."

8.6.3. Construction

8.6.3.1. Forms shall be sufficiently tight to prevent leakage of mortar.

8.6.3.2. Forms shall be properly braced or tied together so as to maintain the desired position and shape during and after placing concrete.

8.6.3.3. Forms shall be designed and constructed for removal without damage to the concrete.

8.6.3.4. Openings shall be provided as necessary to permit placing concrete in a manner which will prevent segregation or accumulations of hardened concrete on reinforcement above the concrete level.

8.6.3.5. Knot holes and broken places which would come into contact with concrete shall be covered with metal patches.

8.6.3.6. Temporary openings shall be provided for adequate cleaning and inspection of formwork.

8.6.3.7. Where indicated, suitable stripping shall be placed in forms to shape edges or surfaces of concrete. Exposed corners shall be chamfered 3/4-inch unless noted otherwise.

8.6.4. Surface Treatment. Before any reinforcement is placed, forms shall be oiled.

8.6.5. Setting Embedded Items Other Than In Drilled Piers. Prior to placement of concrete and during formwork operations, the Contractor shall properly locate and set all items to be placed in the forms or set into the concrete. Templates will be required in setting anchor bolts, and shall be

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furnished by the Contractor. Supports holding the embedded items in place shall, except as noted otherwise, be furnished by the Contractor. Tolerances for setting anchor bolts other than in drilled heliostat foundation piers shall be in accordance with the Drawings, or in accordance with the AISC "Code of Standard Practice," whichever is more restrictive. Requirements applicable to setting anchor bolts in heliostat foundation piers are specified in Article 6.0., DRILLED PIERS.

8.6.5.1. Field welding to anchor bolts will not be permitted.

8.6.6. Inspection. Formwork, reinforcing and embedded items shall have been inspected and approved before the forms are closed or concrete ordered for placement therein. The Contractor shall, in each case, allow the Construction Manager a minimum of eight (8) working hours notice prior to anticipated start of pour to permit sufficient time for such inspection.

8.6.7. Removal of Forms

8.6.7.1. The minimum waiting period before stripping of forms shall be in conformance with Table 5.1.7 of ACI 306. The use of this table shall not relieve the Contractor of responsibility for the safety of or damage to the work.

8.6.7.2. Tie-rod clamps to be removed from the forms shall be loosened 24 hours after concrete placement, except as otherwise specified herein. Form ties, except those required to hold the forms in place, may be removed at that time.

8.6.7.3. Forms left in place for moist curing shall not be loosened for the entire curing period.

8.7. Reinforcing Steel Installation.

8.7.1. General.

8.7.1.1. Reinforcing steel shall be detailed, fabricated, and furnished by the Contractor. Reinforcing materials are specified in Paragraph 8.2.2. The Contractor shall furnish detail fabrication and erection drawings and certified copies of mill test reports for the reinforcing steel furnished hereunder in accordance with Article 4.0, DRAWING AND DATA SUBMITTALS.

8.7.1.2. Reinforcing steel delivered to the site shall be stored off the ground. Before placement, reinforcing steel shall be thoroughly cleaned of loose or flaky rust, mill scale, or coatings of any foreign substance that would reduce or destroy the bond. Reinforcing steel reduced in section shall not be used. In the event of a substantial work delay, previously placed reinforcing steel left for future bonding shall be inspected and cleaned. Reinforcing steel shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on the Drawings shall not be used.

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8.7.1.3. The use of heat to bend or straighten reinforcing steel shall not be permitted. Field splices, if required, shall be made with a wire-tied lap of not less than the number of diameters indicated in ACI 318 for the proper class of splice as shown on the Drawings. Field splices not indicated on the Drawings will not be permitted.

8.7.1.4. The clear distance between parallel bars shall be not less than the nominal diameter of the bars, 1-1/3 times the maximum size of the coarse aggregate, or 1 inch, whichever is greater.

8.7.2 Design and Details. Unless otherwise indicated, the design of reinforced concrete structures will conform to ACI 318, and the details of reinforcing steel will conform to ACI 315. Unless otherwise indicated, construction shall conform to the following requirements:

8.7.2.1. Concrete Covering Over Steel Reinforcement. The thickness of the concrete cover over steel reinforcement shall not be less than the diameter of the round bars and in the following specific instances, not less than specified below:

Drilled piers and other concrete deposited in contact with the ground:	3 inches between steel and ground
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Structures where surfaces are in contact with water plus freezing and thawing:	3 inches
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Concrete surfaces which, after removal of forms, are exposed to weather:

For bars No. 6 and larger:	2 inches
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For bars No. 5 and smaller:	1-1/2 inches
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8.7.3. Supports. Reinforcing shall be accurately placed and securely tied at intersections and splices with black annealed wire sufficiently to prevent displacement during handling and concreting. Reinforcement shall be securely held in position during the placing of concrete by spacers, chairs, or other approved supports. Supports shall be galvanized when the finished concrete is to be exposed. Wire tie-ends shall point away from the form. Unless otherwise indicated, the number, type and spacing of supports shall conform to ACI 315. Tack welding of reinforcing steel assemblies will not be permitted. Reinforcing for slabs on grade, and footing reinforcement, shall be supported by precast concrete blocks. The blocks shall be spaced at intervals as required by the size of reinforcement in order to maintain the reinforcement at the specified minimum height above the underside of slab or footing.

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8.7.4. Accessories. Accessories such as bar supports, spacers and ties shall be furnished and arranged in accordance with the CRSI "Manual of Standard Practice for Reinforced Concrete Construction."

8.8. Preparation for Placing Concrete

8.8.1. Water shall be removed from excavations before concrete is deposited. Any flow of water shall be diverted through proper side drains, and shall be removed without flowing over freshly deposited concrete. Hardened concrete, debris, and foreign materials shall be removed from the interior of forms, and from inner surfaces of conveying equipment.

8.8.2. Reinforcement shall be secured in position, inspected and approved before depositing concrete. Runways shall be provided for wheeled concrete-handling equipment. In addition, the equipment shall not be wheeled over reinforcement, nor shall runways be supported on reinforcement.

8.8.3. The subgrade for mat pours shall be finished to the exact section of the bottom of the mat pour, and shall be maintained in a smooth, compacted condition, in conformity with the required section and grade until the concrete is placed. Where concrete is placed directly on earth, the subgrade shall be clean and thoroughly moistened, but not muddy, at the time the concrete is deposited.

8.8.4. Placement of concrete shall not be commenced until reinforcement and items set into the forms have been inspected by the Construction Manager.

8.9. Placing Concrete

8.9.1. General

8.9.1.1. Concrete shall be handled from transport vehicle to place of final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss in ingredients until the approved unit of operation is completed.

8.9.1.2. Concrete that has attained its initial set or otherwise becomes unsuitable for placement, as determined in accordance with ASTM C94, shall not be placed in the work. Placement will not be permitted, when the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete.

8.9.1.3. Concrete shall be placed in the forms in uniform layers as nearly as practicable in final position. Forms or reinforcement splashed with concrete shall be cleaned in advance of pouring subsequent lifts. Immediately after placing, concrete shall be compacted by thorough agitation in an approved manner. Tapping or other external vibration of forms shall not be permitted.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

8.9.1.4. Concrete shall be placed in the forms in a planned sequence to avoid cold joints. Concrete shall not be allowed to drop freely more than 5 feet in unexposed work nor more than 3 feet in exposed work; where greater drops are required, a tremie or other approved means shall be employed. The discharge of the tremies shall be controlled in order that the concrete may be effectively compacted into horizontal layers not more than 24 inches thick, and the spacing of tremies shall be such that segregation does not occur. Concrete to receive other construction shall be screeded to the proper level to avoid excessive shimming or grouting.

8.9.2. Cold-Weather Requirements. Concrete shall not be placed when the ambient temperature is 40 degrees F or less, unless special precautions are taken. Protection methods shall be in accordance with ACI 306 "Recommended Practice for Cold Weather Concreting." Concrete damaged by freezing shall be removed and replaced by the Contractor.

8.9.3. Hot-Weather Requirements. In hot weather, concrete shall be placed in accordance with the recommendations of ACI 305.

8.9.4. Joints

8.9.4.1. Construction Joints. Work shall be planned so as to require a minimum of field located construction joints. The type, number and locations of these construction joints shall be as shown on the Drawings. Properly designed shear keys shall be provided where indicated on the Drawings. Reinforcement shall be continued through construction joints.

8.9.4.2. Expansion and Contraction Joints. Expansion and contraction joints shall be installed as shown on the Drawings.

8.9.5. Placing Methods. Concrete shall be conveyed and placed as rapidly as practicable, either by manual or mechanical means that will prevent segregation or loss of ingredients. Aluminum shall not be used to convey or place concrete. Concrete shall be deposited continuously in horizontal layers, in a manner to prevent displacing reinforcement and accumulation of concrete on the forms or the reinforcement above the fresh concrete.

8.9.5.1. Chuting. Chutes shall be of rounded cross-section to avoid accumulation of concrete in corners. The slopes of chutes shall be steep enough to permit flow without requiring a slump greater than that specified or required for placement (slope usually 1 vertical to 2 or 2-1/2 horizontal). In intermittent operations when free movement of concrete in the chute is not possible, the concrete shall be discharged into approved hoppers. Chutes and hoppers shall be thoroughly cleaned before and after each run. Wash water debris shall be discharged outside of forms.

8.9.5.2. Pumping. Where concrete is conveyed and placed by mechanically applied pressure, the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

is completed, the concrete remaining in the pipeline shall be ejected in such manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

8.9.6. Consolidation. During and immediately after placing, concrete shall be consolidated and worked to provide thorough consolidation around all reinforcement, embedded items, and into corners of forms. Consolidation shall be accomplished by the use of high frequency internal vibrators. The type and operation of vibrators is subject to approval by the Construction Manager. Consolidation procedure shall conform generally to ACI 304 and the following:

8.9.6.1. Placement of Layers. Concrete layers shall not exceed 2 feet in thickness. Each layer shall be thoroughly consolidated before the succeeding layer is placed. Timing of placement shall be such that each succeeding layer is placed before the preceding layer has reached its initial set.

8.9.6.2. Extent of Vibration. Vibration shall extend through the entire depth of each new layer and several inches into the preceding layer. Vibration shall be applied to the point of deposit and uniformly throughout the freshly placed concrete.

8.9.6.3. Duration of Vibration. Vibration shall be performed such as to secure the desired results within 5 to 15 seconds at points 18 to 30 inches apart rather than vibrating for longer periods at wider intervals. To prevent segregation of mix, vibration shall be continued only long enough to accomplish thorough consolidation and complete embedment of the reinforcement and fixtures.

8.9.6.4. Limitations. Vibrators shall not be used as a means of moving concrete inside the forms. This action shall be accomplished by correct initial placement augmented by the use of hand shovels. The Contractor shall provide a sufficient number of vibrators so that consolidation can be accomplished immediately after the concrete has been deposited in the forms.

8.10. Bonding Joints or Resuming Placement on Hardened Concrete

8.10.1. Concrete on which other concrete is placed shall be either still plastic or thoroughly hardened, but not in a semi-hardened state that may be disturbed or weakened by the added load and the jarring.

8.10.2. To provide bond between successive lifts of concrete, the exposed surface of the hardened concrete shall be cleaned and roughened, without loosening the embedded aggregate. Concrete surfaces on which other concrete is to be placed shall be kept wet for the 24 hours previous to the pour.

8.10.3. Brooms or air-water jets shall be used after the start of initial setting of the cement. Sandblasting or air-tooling shall be employed after the concrete has hardened. The surface film and laitance or diluted paste shall be removed and a reasonably high percentage of aggregate exposed.

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TECHNICAL INFORMATION (CONTD)

8.10.4. When the new concrete is placed, the old surface shall be clean, damp and free from standing pools of water.

8.10.5. Batches of neat cement or of mortar having about the same proportion of cement to sand as used in the concrete, shall be deposited and well brushed in, just ahead of the new concrete.

8.11. Repairing and Patching Surfaces. Concrete surfaces shall be repaired immediately after form removal, in accordance with the following procedure:

8.11.1. Holes left by tie rods shall be hammer-packed with stiff, dry-pack mortar of the same materials as, but somewhat leaner than, the concrete.

8.11.2. Honeycombed areas shall be removed to a depth at which sound concrete is exposed. Cut-out areas shall be straight at right angles to the surface, and filled with concrete matching that of the structure.

8.11.3. Spalled and pitted areas resulting from concrete sticking to the forms shall be chipped back to obtain a good mechanical bond, undercut at the edges, and repaired with mortar matching the concrete.

8.11.4. Rough areas and high spots shall be ground flush and smooth.

8.11.5. Before mortar is placed in patches, a grout of cement and water mixed to the consistency of paint shall be brushed into the surfaces to which the new material is to be bonded.

8.11.6. On concrete which will be exposed in finished work, approximately 20 percent white cement shall be mixed with the gray matching cement to offset the tendency of patches to show up darker than the surrounding concrete.

8.11.7. Throughout finishing operations and repairing of defects, the surface shall not be allowed to become dry (damp cure for 72 hours), nor shall the underlying concrete be damaged.

8.11.8. Finished repairs will be inspected. Unsatisfactory repairs shall be redone by and at the expense of the Contractor as directed by the Construction Manager.

8.12. Concrete Finishes

8.12.1. General. Concrete surfaces shall be given finishes in accordance with the following and as shown on the Drawings.

8.12.1.1. Formed concrete surfaces against which backfill will be placed, and which will therefore be concealed in the finished work, shall have all fins and burrs removed, all tie rod holes packed, and all defects repaired. No other finishing will be required.



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8.12.1.2. Formed concrete surfaces which will remain exposed to view in the finished work, shall be given smooth finish.

8.12.1.3. Where indicated, slab surfaces shall be given a broomed finish.

8.12.1.4. Surfaces which will subsequently be grouted for support of column baseplates, equipment, etc., shall be given a float finish.

8.12.2. Float Finish. Floating shall be accomplished by either wood, cork, or metal floats or by a finishing machine. After the concrete has been properly placed, vibrated, and roughly leveled, it shall be screeded off to the proper elevation. All coarse aggregate shall be pushed below the surface. The use of "jitterbugs" shall not be permitted. After screeding and tamping of coarse aggregate, the surface shall be made uniform by means of bull floats operated with a horizontal motion. After floating, the surface shall be tested for uniformity by use of a straightedge. Variations from desired finished elevations shall not exceed 1/4 inch in ten feet. Use of neat cement to absorb excess surface moisture is prohibited.

8.12.3. Monolithic Finish. Where monolithic finish is required, the concrete shall be finished by minimum floating the concrete to force the coarse aggregate away from the surface, then screeding and floating with straight edges to bring the surface to the required finish level. While the concrete is still green but sufficiently hardened to bear a man's weight without deep imprint, it shall be wood-floated to a true, even plane with no coarse aggregate visible. Sufficient pressure shall be used on the wood floats to bring moisture to the surface. After the surface moisture has disappeared, concrete surfaces shall be steel-troweled to a smooth, even finish, free from trowel marks. After the concrete has set enough to ring the trowel, all concrete surfaces which remain exposed to view in the finished work shall be given a second steel troweling to a burnished finish. Variations from desired finished elevations shall not exceed 1/4 inch in ten feet. Use of neat cement to absorb excess surface moisture is prohibited.

8.12.4. Broomed Finish. Where a broomed finish surface is required, floating as specified for Float Finish shall be completed and the surface finished by brooming. The brooms shall be of the push broom or floor brush type. The brooms shall be drawn across the surface from the centerline to each side with not more than one stroke per width of broom, slightly overlapping adjacent strokes. The brooming operation shall be so executed that the corrugations provided in the surface will be uniform in appearance and not more than 1/16 inch in depth. Sufficient time shall be allowed before starting brooming to permit surplus water and laitance to rise to the surface. The brooming operation shall be completed before the concrete is in such condition that it will be torn or unduly roughened, and before initial set has developed.

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8.12.5. Smooth Finish. Smooth finish for formed concrete surfaces shall consist of thoroughly wetting and brush-coating the surfaces with cement grout composed of 1 part light colored Portland cement to 2 parts fine aggregate, mixed with water to the consistency of thick paint. Grout shall be cork- or wood-floated to fill all pits, air bubbles, and surface holes. Excess grout shall be scraped off with a trowel and the surface rubbed with burlap to remove any visible grout film. In hot, dry weather, the grout shall be kept damp by means of a fog spray during the setting period. The finish for any area shall be completed in the same day, and the limits of a finished area shall be established at natural breaks in the finished surface.

8.13. Protection and Curing. Protection and curing shall be accomplished by preventing loss of moisture, rapid temperature change, mechanical injury, or damage from rain, frost or flowing water. Curing shall be started as soon after placing and finishing as the surface conditions are suitable. Curing of formed surfaces shall be accomplished by moist curing with forms in place for the full curing period, or, if forms are removed prior to the end of the curing period, by any of the following methods, or combinations thereof:

8.13.1. Minimum Curing Periods. The following shall be the minimum curing periods for all concrete placed hereunder, except as noted in ACI 306:

<u>Curing Temperature</u>	<u>Curing Period</u>
50 to 70 degrees F	7 days
70 to 100 degrees F	5 days

8.13.2. Protective Wet Curing. The protective medium for wet curing shall consist of saturated cotton mats or a double layer of burlap, of sufficient size to cover the entire concrete surface and side forms. The mats or burlap shall be kept continually wet during its use. After finishing operations and prior to start of protective wet curing, the concrete surface shall be kept wet with adequate fog spraying equipment. During any change in curing medium, the concrete shall not remain exposed for more than one hour.

8.13.3. Moist Curing. Unformed surfaces shall be covered with burlap, cotton or other approved fabric mats kept in contact with the surface, or with sand, and shall be kept continually wet. Where formed surfaces are cured in the forms, the forms shall be kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials. Burlap shall be in two layers.

8.13.4. Waterproof-Paper Curing. Surfaces shall be covered with waterproof paper with 4 inches of overlap at sides and ends and sealed with mastic or pressure-sensitive tape not less than 1-1/2 inches in width. The paper shall be weighted to prevent displacement, and tears or holes occurring during the curing period shall be immediately repaired by patching.

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TECHNICAL INFORMATION (CONTD)

8.13.5. Membrane Curing

8.13.5.1. Pressure spray curing compounds shall be of the type previously specified. The compound shall be applied according to the manufacturer's directions and shall be applied immediately after finishing operations are completed and after forms are removed. The quantity shall be sufficient to ensure the formation of a continuous unbroken film. The curing compound shall be applied to the entire area of the exposed surface, and shall be applied in two separate applications, each of which shall be by an even sweeping motion of the nozzle with sufficient overlap to ensure uniform and complete coverage. The second application shall follow five to thirty minutes after the first application and shall be applied to cross and recross the sweep of the first application.

8.13.5.2. Curing compound shall not be used or permitted on surfaces where future bonding, concrete hardener, or painting is indicated. Such surfaces shall be moist cured as previously specified.

8.13.5.3. After final application of the compound, surfaces shall be protected from traffic and other damage to the membrane for a period of curing as specified hereinafter.

8.13.5.4. The use of any membrane material which will impart a slippery surface to the concrete or alter its natural color shall not be permitted. The compound, however, shall contain a fugitive dye of color strength sufficient to render the film distinctly visible on the concrete surface for a period of at least four hours after application. The compound shall be such that it will harden within thirty (30) minutes.

8.13.5.5. If concrete surfaces are expected to be exposed to freezing temperatures within five (5) days, membrane curing compound shall not be used.

8.13.6. Polyethylene Sheeting and Polyethylene-Coated Waterproof Paper and Burlap. Surfaces shall be completely covered. Where a single sheet does not cover the entire surface, ends and sides shall be lapped not less than 4 inches and sealed with pressure-sensitive tape.

8.14. Protection. The Contractor shall be fully responsible for protecting his finished concrete work from damage, marring of finish, discoloration or other detrimental conditions during curing and his subsequent construction operations.

8.14.1. After the curing periods specified, concrete shall not be allowed to heat or cool faster than at a rate of 5 degrees F per hour, or 20 degrees F per twenty-four hour period, until outside temperatures are reached. Either dry or steam heat will be an acceptable means of maintaining temperature control.

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TECHNICAL INFORMATION (CONTD)

8.14.2. Open type or oil pot salamanders are prohibited for temporary heating purposes.

8.14.3. Heaters shall not be placed directly upon uncured concrete.

8.14.4. When the air temperature is expected to exceed 90 degrees F within forty-eight hours after placement, all surfaces shall be protected from direct sunlight for a minimum period of forty-eight hours. The use of membrane curing compound alone does not satisfy this requirement.

SECTION 4 - IFB  
TECHNICAL INFORMATION (CONTD)

9.0 CLEAN-UP

After completion of the work of this Contract, and before final acceptance of the work will be given, the Contractor shall remove all the Contractor's tools, equipment, temporary structures, surplus materials, trash, empty containers and other evidence of construction from his work, parking and storage areas and leave those areas clean to the satisfaction of the Construction Manager.

DIVISION USAGE					
MM	P	PP	SH	FI	SP
	X			X	

# Stearns-Roger

INCORPORATED  
ENGINEERING STANDARD

STANDARD NUMBER  
FC 20.01.9

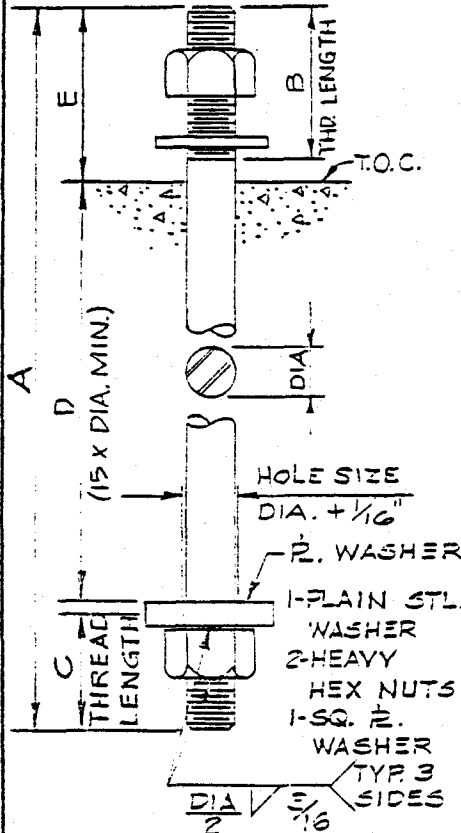
APPROVALS  
Des. Sect. \_\_\_\_\_  
Sect. Supv. *W. J. [Signature]*  
Div. *W. J. [Signature]*

ROD BOLT "RB" & PLATE WASHER

PAGE 1 OF 1  
ISSUED 3-31-77  
REVISED 4-4-77

TOP OF R. BOLT TO BE FLAT AND CENTER PUNCHED BY FAB.

ALL DIMENSIONS IN INCHES  
TAG EACH GROUP WITH MARK AND DWG. NO.



NO. REQ	MARK		THREAD LENGTH			EMBED D	PROJ. E	PLATE WASHER		REMARKS
	DIA	TYPE	A	B	C			SQ. SIZE	THK.	
	1/2	RB	3	2	7 1/2			1 1/2	1/8	
	3/8	RB	4	2 1/2	9 1/2			1 1/2	1/8	
	1/2	RB	4	2 1/2	11 1/2			2	1/8	
	3/4	RB	4	2 1/2	13 1/2			2 1/2	1/8	
	1	RB	4	2 1/2	15			2 3/4	1/8	
	1 1/4	RB	5	3	17			3	1/8	
	1 1/2	RB	5	3	19			3 1/2	1	
	1 3/4	RB	6	3	21			3 3/4	1	
	2	RB	6	3	22 1/2			4	1 1/8	
	2 1/4	RB	6	4	26 1/2			4 1/2	1 1/8	
	2 1/2	RB	7	4	30			5 1/2	2	
	2 3/4	RB	7	4	34			6	2 1/8	
	3	RB	8	4	37 1/2			6 3/4	2 1/8	
	3 1/4	RB	9	5	41 1/2			7 1/2	2 3/8	
	3 1/2	RB	9	5	45			8 1/2	3	
	3 3/4	RB	10	5	49			9	3 1/8	
	4	RB	10	5	52 1/2			9 1/2	3 1/8	
	4 1/4	RB	11	6	56 1/2			10 1/2	3 3/8	
	4 1/2	RB	11	6	60			11	4	
	4 3/4	RB	12	6	64			11 1/2	4 1/8	
	5	RB	13	6	67 1/2			12 1/2	4 1/2	

SPECIFICATION: ASTM A-307

MATERIAL:  
ROD BOLT-ASTM A-36  
NUTS-ASTM A-307 GR. B  
R. WASHER-ASTM A-36  
PLAIN WASHER-ANSI  
B18.22.1-1965 (R1975)  
TYPE B, REGULAR  
ELECTRODES-EG016

\* MARK NUMBERS SUFFIXED WITH (G) INDICATE ITEMS TO BE GALVANIZED AFTER FABRICATION AS PER ASTM A153-73

PRINT RECORD						ENG. RECORD					
DATE						DRAWN					
FOR						CHECKED					
REVISED						APPROVED					
CUSTOMER						RB ( )					
FIELD											
INTRA CO.						PAGE ____ OF ____					

DIVISION USAGE						<b>Stearns-Roger</b> <small>INCORPORATED</small> <b>ENGINEERING STANDARD</b>	STANDARD NUMBER					
MM	P	PP	SH	FI	SP		FJ 60.60					
APPROVALS: Des. Sect. <i>[Signature]</i> Sect. <i>[Signature]</i> Div. <i>[Signature]</i>						<b>DOCUMENTATION REQUIREMENTS</b> PROJECT: SOLAR ONE CONTRACT/REQUISITION NUMBER: CONSTRUCTION PKG. #6 TITLE: COLLECTOR SUBSYSTEM FOUNDATION CONSTRUCTION		C-21700  ISSUED 7/16/79 REVISED				
TYPE OF DOCUMENTATION						TYPE OF COPIES	FOR REVIEW		FINAL		REVIEW REQ'D BEFORE FAB.**	CTFY. FINAL ISSUE ***
							NO. OF COPIES	WEEKS AFTER AWARD*	NO. OF COPIES	"X" IF REQ'D		
<b>1-ENGINEERING DRAWINGS</b>						Repro-ducibles						
A-Outline, General Arrangement and Principal Dimensions						Prints						
B-Cross Sections												
C-Foundation Requirements, including Loadings & Anchoring Locations												
D-Physical Locations of Piping and/or Wiring Terminals												
E-Control Diagrams												
F-Electrical Schematic Diagrams												
G-Wiring Diagrams, including Internal External and Interconnecting												
H-Standard Hardware Items												
<b>2-ERECTION OR INSTALLATION INFO.</b>						Repro-ducibles	3		3			
A-Shop Fabrication Drawings						Prints	0		0			
B-Erection or Installation Drawings								4	X	X	X	
C-Erection or Install. Instructions						Copies		4	X	X	X	
<b>3-SPECIAL DOCUMENTATION</b>												
A-Performance Data, including Curves						Copies						
B-Design Calculations						Copies						
C-Test Reports +++++						Copies	8	4	8	X		
D-Code Papers and Certificates						Copies						
E-Shop Fab. and/or Welding Proced.						Copies						
F-Shop Fabrication Reports						Copies						
G-Welder's Qualification Reports						Copies						
H-As Built Survey						Copies			2	X		X
<b>4-MISCELLANEOUS</b>												
A-Operation and Maintenance Manuals						Manuals						
B-Recommended Spare Parts List for 1 Year's Operation, with Unit Prices						Copies						
C-Bills of Material						Copies			8	X#		
D-Definitive Drawing List						Copies	8	4				
<p>*-Entries in the column "WEEKS AFTER AWARD" designate which types of review documentation are required. Blank spaces in this column denote that review documentation is not required.</p> <p>**-"X" in this column means drawing review req'd. before fabric. release.</p> <p>***-"X" in this column means final issue must be certified for construction.</p> <p>++++ - Mill reports required for reinforcing steel and anchor bolt steel.</p> <p>#-At least 2 weeks before each shipment, detailed Bills of Material shall be sent to the plant site.</p> <p>This form supplements requirements specified in Article 4.0 in the Specification.</p>												



DEPARTMENT OF ENERGY

Document Type

Engineering Procedures

Document Number

~~STMP-AL-4~~

Revision Number -0-

Date of Revision

TITLE

10 MWe Solar Pilot Plant

Document Identification

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1. SCOPE

1.1 This procedure establishes the method of identifying drawings, specifications, manuals, procedures and other documentation applicable to the 10 MWe Solar Pilot Plant. It does not apply to internal documentation.

2. RESPONSIBILITIES

2.1 The Project Director shall be responsible for implementing and administering this procedure.

2.2 The Project Engineer shall be responsible for the following:

2.2.1 The assignment of project identification to all drawings, specifications, manuals and procedures. This shall be accomplished by the assignment of blocks of numbers based upon the system outlined in this procedure.

2.2.2 The maintenance and yearly review of this procedure.

2.3 The administrative officer shall be responsible for maintenance and publication of the document identification records.

3. DEFINITIONS AND REFERENCES

3.1 Definitions:

3.1.1 Designers - SFDI, CSS, SCE, or subcontractor design entities.

3.1.2 SFDI - Solar Facilities Design Integrator

3.1.3 CSS - Collector Subsystem Supplier(s)

3.1.4 SCE - Southern California Edison

3.1.5 Vendor - A supplier of material parts and components or services.

3.1.6 RS - Receiver Subsystem





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- 3.1.7 TGF - Turbine Generator Facilities
- 3.1.8 TSS - Thermal Storage Subsystem
- 3.1.9 CS - Collector Subsystem
- 3.1.10 MCS - Master Control Subsystem
- 3.1.11 BCS - Beam Characterization Subsystem
- 3.1.12 PSS - Plant Support Subsystem
- 3.1.13 ICD - Interface Control Document
- 3.1.14 GPL - General Plant Layout
- 3.1.15 FD - Field Drawing - A drawing produced in the field.

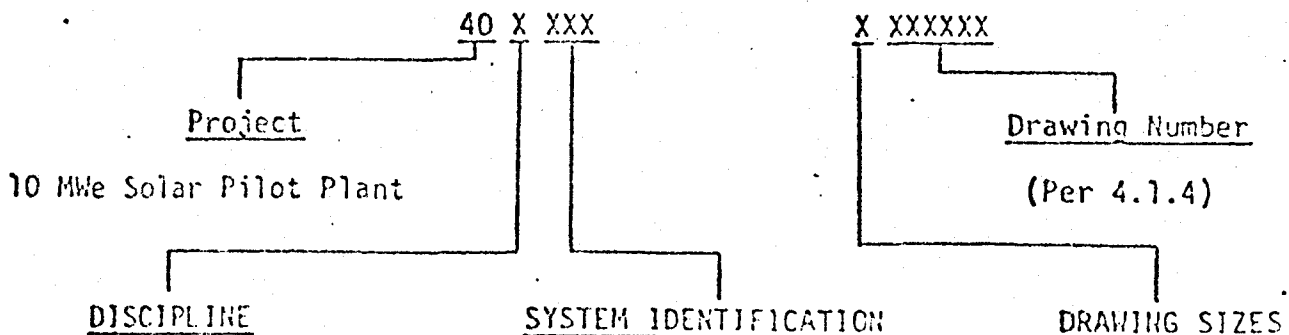
3.2 References

- 3.2.1 Document approval release revision procedure STMPO-A2

4. IMPLEMENTATION

4.1 Drawing Identification System:

- 4.1.1 The following Drawing Identification format shall be used:



- A = Architectural
- C = Civil/Structural
- E = Electrical
- M = Mechanical
- P = P&PID'S
- J = Instrumentation
- X = Conceptual
- O = Overall Design Description

- GPL = 100
- RS = 200
- TSS = 300
- MCS = 400
- CS = 500
- BCS = 600
- PSS = 700
- ICD = 800
- TGF = 900

- 2 = B Size = 11" x 17"
- 3 = C Size = 18" x 24"
- 5 = E Size = 30" x 42"



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4.1.2 All drawings shall have a title block containing a minimum of the following information:

- a) 10 MWe Solar Pilot Plant
- b) Title
- c) Identification Number
- d) Approval Signature and Approval Date
- e) Issue Date
- f) Revision Letter or Number and Revision Date

4.1.2:1 Revisions shall be designated with a letter for all preliminary designs with the Revision Notation changing to Zero (0) for Approved For Construction issues. Revisions to Approved For Construction documents shall be designated with successive numbers.

4.1.3 All drawings shall contain a Revision Block containing a minimum of the following information:

- a) Revision Identification Letter or Number
- b) Revision Description
- c) Approval Signature
- d) Approval Date

4.1.4 The following blocks of identification numbers shall be used by the Project Engineer in the assignment of drawing identification.

- a) RS - 131600 - 131999
- b) TSS - 132000 - 132199
- c) MCS - 132200 - 132699
- d) CS - 132700 - 132899
- e) BCS - 132900 - 133099
- f) PSS - 133100 - 133299
- g) TGF - 133300 - 133499
- h) GPL - 133900 - 133949
- i) ICD - 133950 - 133999



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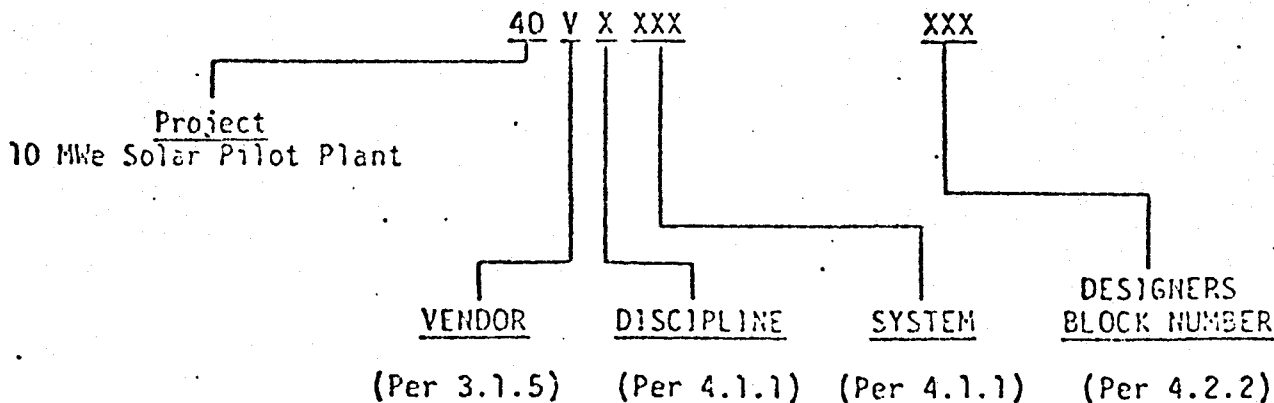
4.1.5 All drawings shall contain a "Bill of Material", where appropriate and shall provide the following:

- a) Item Number
- b) Description or Name
- c) Quantity
- d) Purchase Order Number
- e) Manufacturer or Supplier
- f) Reference Drawing, Specification Number or Catalog Number

4.1.6 The System Identification Number, (4.1.1), can be developed further to more precisely identify a system if required i.e., RS = 200 can be divided into 200 to 299 to facilitate a further breakdown of the Receiver Subsystem.

4.2 Vendor Drawing Identification System:

4.2.1 The following vendor drawing format shall be used:



4.2.2 The designers shall assign their vendors with blocks of numbers in sequential order, e.g., vendor "A" - 1 to 300, vendor "B" - 301 to 400.



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Document Number

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Revision Number -0-

TITLE

10 MWe Solar Pilot Plant

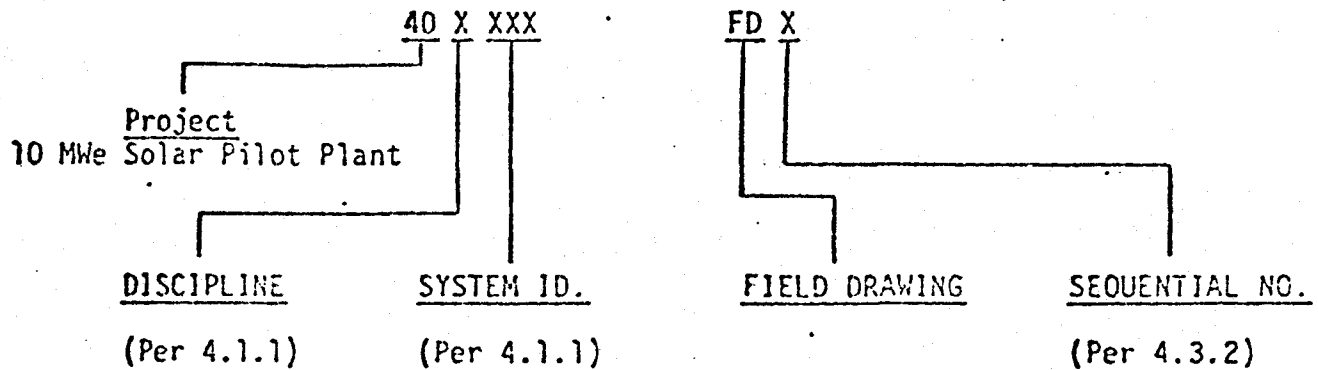
Date of Revision

Document Identification

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4.3 Field Drawing Identification System:

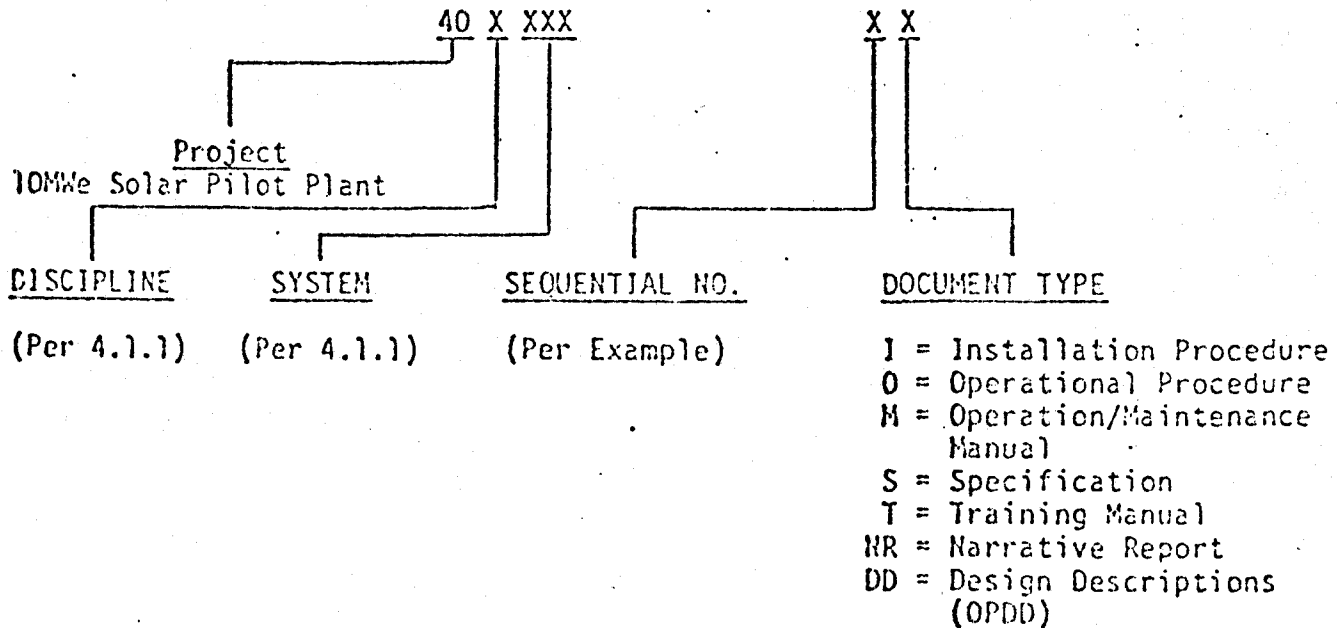
4.3.1 The following drawing identification format shall be used:




4.3.2 The Project Engineer shall assign the sequential numbers beginning with the number one (1) for each system.

4.4 Specifications, operation/maintenance manuals, training manuals, installation and/or operational procedures, reports and design descriptions identification system

4.4.1 The following identification format shall be used:



	DEPARTMENT OF ENERGY	Document Number STMPO-A1
	Document Type Engineering Procedures	Revision Number -0-
TITLE 10 MWe Solar Pilot Plant		Date of Revision
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EXAMPLE:

- 40 X 100 - 1S = Conceptual Receiver System Specification
- 40 E 100 - 2S = Receiver System Electrical Specification
- 40 E 300 - 1M = TSS Electrical O/M Manual

4.4.2 The sequential number allows for more than one specification, O/P manual, training manual and installation procedure to be issued for each system.

5.0 Record Keeping & Publication

- 5.1 A journal record shall be kept of the documents issued by STMPO which shall include: the title, the document number, the revision, the issuance date, the end usage (e.g., for information, for official use, for construction, for review, etc.) and the releasing documentation (Ref. Procedure \_\_\_\_\_)
- 5.2 A periodic listing of the documents issued by STMPO shall be published and sent to the identified list of participants which shall serve as a current issue list and includes:
  - a. Document number
  - b. Document title
  - c. Document Revision \_\_\_\_\_ Document release date
  - d. Document release record number
  - e. Document release record date