Statement Of Work: A2 & N7 Wide Head Turbine

Department of the Interior

Bureau of Reclamation

LCDO - Hoover Dam

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SECTION 1 - GENERAL

1.01 SUMMARY

A. This requirement is being solicited on a sole source basis pursuant to FAR 6.3021(a)(2), Only One Responsible Source. The turbine runners for Units A2 and N7 must be hydraulically and dimensionally identical to the existing Wide Head runner designs installed in Units A1, N5, N6, and N8. Compatibility with existing hydraulic performance characteristics, cavitation behavior, structural safety factors, and the Hoover Dam runner interface geometry requires the use of this same design and manufacturing source.

B. The work is located at Hoover Dam and Powerplant, approximately 8 miles northeast of Boulder City, Nevada and 32 miles from Las Vegas, Nevada in Clark County, Nevada and Mohave County, Arizona.

C. Principal features of the work under this solicitation include:

1. Hydraulic turbine runner manufacturing and delivery of two (2) 196,000 HP turbine runners, one for Unit A2 (counterclockwise) and one for Unit N7 (clockwise), including associated runner cone and coupling bolts and nuts.
2. Design and installation of a roughening air system, including the pipework leading into the headcover and a support cone for the pipework in the turbine runner.
3. The supply of two upper and two lower stationary seal rings for the two units (1 upper and 1 lower per unit).
4. In-place machining of the four new stationary seal rings.
5. Providing a contractor engineer to witness performance testing to determine if the newly installed turbine runners meet hydroelectric efficiency guarantees.
    a. The cost is to be included in the lump sum schedule prices for each turbine runner.

D. The two new turbine runners shall be hydraulically similar to the turbine runners supplied to the Hoover Dam previously for N8, N5, N6, and A1 in Contract No. R10PC30013. N7 shall use the design for N5/6 (clockwise) and A2 shall use the design for A1 (counterclockwise).

1.02 DEFINITIONS

ASME	American Society of Mechanical Engineers.
ASNT	American Society for Nondestructive Testing.
ASTM	American Society for Testing and Materials International.
AWS	American Welding Society
CFD	Computational Fluid Dynamics
CLIN	Contract Line-Item Number

CO	Contracting Officer
COR	Contracting Officer Representative
Days	Calendar days.
FEA	Finite Element Analysis
IEC	International Electrotechnical Commission
MT	Magnetic Particle Testing
NDT	Non-Destructive Testing
PT	Dye Penetrant Testing
Ra	Roughness average
RFI	Request For Information
RSN	Required Submittal Number, identifies items to be submitted together as a complete submittal.
RT	Radiographic Testing
SOW	Statement of Work,
Submittals	Includes drawings, data, manuals, certifications, test reports, curves, samples, brochures, and other items furnished by the Contractor for approval, informational, or other purposes.
UT	Ultrasonic Testing

1.03 CURRENT EQUIPMENT

A. The Lower Colorado Dams Office (LCDO) currently operates 19 hydro units at Hoover Dam, including 17 large generators (15 with nominal capacity of 130 MW each and 2 with nominal capacity of 60 MW each) and 2 small station service generators with nominal capacity of 3 MW each.

B. The turbine systems for units A2 and N7 were originally supplied by Baldwin Southwark. New replacement turbine runners manufactured by Voest Alpine were installed in 1989 for A2 and 1982 for N7.

1.04 SCHEDULE FOR THE WORK

A. The Government anticipates issuing the sole source award on or about November 30, 2026. All milestone dates below are based on this projected award date and will be adjusted if the award date changes.

B. Milestone Schedule Dates during this contract:

DATE	ACTION ITEM
6/10/2026	Issue Solicitation

8/10/2026	Proposal Due date
11/30/2026	Anticipated contract award date
7/28/2027	New stationary seal rings (2 upper, 2 lower) delivered to Hoover
11/25/2027	In-place machining completed on A2
3/24/2028	In-place machining completed on N7
9/20/2028	Air Admission for A2 and N7 completed (excluding turbine component installation)
11/19/2028	New A2 turbine delivered to Hoover
5/18/2029	New N7 turbine delivered to Hoover

C. The dates listed for receipt of submittals listed in Table 1 - List of Submittals are required dates to be met by the contractor under this contract.

D. Delivery dates are milestones; earlier delivery will be accepted and considered beneficial to the project.

1.05 MEASUREMENT AND PAYMENT

A. Cost:

1. Include cost of submittals in prices offered in the schedule for contract line items.

B. Payment:

1. Ten percent (10%) of the payment for contract line items will be withheld until all submittals related to that item are received and approved by the Government.

1.06 PERSONNEL QUALIFICATIONS

A. If the contractor elects to use a sub-contractor, the awardee of the sub-contracted work must have at least 5 years of experience with work in or related to hydro-electric power.

1. Relevant experience can be tabulated by a total of 5 years, but the most recent experience must be no more than 6 months before the award of this solicitation.
2. Experience will be evaluated by the Government prior to mobilization. The contractor is required to provide the government with an advance of 45 business days prior to sub-contractors expected date to be onsite.
3. The government will have 14 business days after receiving sub-contractor experience to evaluate qualifications.

SECTION 2 - SUBMITTALS

2.01 SUBMITTAL REQUIREMENTS

A. In the case where an RSN described in a separate section of this SOW contains different submittal requirements than listed in this section, contractor shall follow the requirements listed there within.

B. General:
   1. Identify submittal with contract number, title, and RSN.
   2. Submit as an electronic PDF unless otherwise noted.
   3. Units: US customary.

C. Drawings:
   1. Unless otherwise stated, all drawings included in submittals for this solicitation must meet the requirements listed within Section 7.

D. Product Data:
   1. Contractor shall mark the manufacturer's data for commercial products and equipment used in the completion of this contract.
      a. Include manufacturer's name, type, model, size, and characteristics of the product.
      b. Providing markings that products meet requirements of specifications and reference standards as applicable.
      c. Ensure markings are furnished in a manner that is visible and can be photographed.
      d. Strike through any items that do not apply.

E. Certifications:
   1. Certifications must be signed and sealed by a registered professional in the subject which the certification pertains to.
   2. Manufacturer certifications must be signed by an authorized representative of the manufacturer.

F. Castings
   1. Furnish to the COR certificates showing the results of the ladle analysis and material properties.

G. Mill or Shop Orders
   1. The Contractor shall send the COR, upon request, a copy of each mill or shop order for material purchased by the Contractor for use in the fabrication of turbine components.
      a. The copies of the orders are to state the place at which the material is to be manufactured.
      b. All such mill or shop orders are to quote the requirements of the special conditions

and drawings for articles, materials, and supplies to be furnished.

H. Manuals:

1. Copies: Provide hard copies (bound and indexed) and one set of electronic copy either in Word document (.doc) or Adobe Acrobat document (.pdf) format.
2. Contents:
    a. Parts identification lists, lists of special tools, and accessories.
    b. Detailed instructions for installing, operating, lubricating, and maintaining equipment.
    c. As-built drawings and test records or reports required by the specifications.

I. Inlet/Discharge Edge Templates

1. Submit drawings showing positioning of the templates for reference.

J. Photographs and Images:

1. Include contract number, name of equipment, and view title.
2. Digital files shall be submitted in .jpeg format.
3. Photos shall be in 1080p quality or better.
4. Ensure the subject of each photo is visible and photos do not contain blur or camera shake.

2.02 SUBMITTAL PROCEDURES

A. Contractor shall submit complete sets of required materials for each RSN.

B. Provide submittals in accordance with the "No. of sets to be sent to:" column in Table 1 – List of Submittals. Contact information is provided in section 2.04.

C. Transmittal Letters:

1. Contractor shall provide a transmittal letter in .PDF format with submittals
2. Include the following information in transmittal letters:
    a. Contract number and title.
    b. RSN for each attached submittal.
    c. Primary point of contact.
    d. Number of sets for each RSN.
    e. Identify submittal as initial or resubmittal.
3. More than one RSN may be submitted under a transmittal letter, provided the point of contact is the same.

i. Submittals not approved:

1. Revise and resubmit for approval.
2. Show changes and revisions with revision date.
    a. Resubmitted drawings shall include a revision block with the date of revision.
3. Describe reasons for significant changes in transmittal letter.
4. Resubmit returned submittals within 14 days after receiving the comments, unless otherwise specified.
5. Requirements for initial submittals apply to resubmittals.
6. Resubmittals shall include all items required for the submittal without reference to the original submittal.
7. The contractor shall not change designs without re-approval of the COR after drawings, documentation, and technical data have been approved by the COR.

2.03 REVIEW OF SUBMITTALS

A. Submit all submittals to the COR for review and acceptance.

B. Time Required:
    1. Submittal review will be completed within 21 days for each submittal or resubmittal, unless otherwise specified.
    2. Time required for review begins after the complete set of materials required for a particular submittal or resubmittal are received by the government.

C. Time in Excess of Specified:
    1. The CO may extend the required delivery date for submittals to allow additional time for completing work affected by extended review times.
        a. The time extension will be to the extent that extended review time caused a delay to the required contract completion date.
        b. Time extension will not exceed time used in excess.

D. Return of Submittals:
    1. Return of submittals will be by email or hard copy as applicable.
    2. One set of submittals required for approval will be returned either approved, approved subject to identified changes, or not approved.
        a. Submittals that are not approved shall be revised and resubmitted for approval.
        b. No details of a submittal item may be changed after the submittal has been approved without approval from the CO and review of proposed changes.
        c. Exception: Schedules may be accepted, partially accepted, or not accepted.

3. Responses to RFIs shall be provided to contractor within 14 days of receiving the request.
4. Responses to general correspondence with the COR shall be provided within 14 days.

2.04 TRANSMITTAL ADDRESSES

A. Provide transmittal letters and RSNs to the following. See Table 1 - List of Submittals, column: No. of Sets to be Sent to, to determine which address(s) to send the given quantity of transmittal and submittal items to.

B. Information regarding transmittal addresses, including the Contracting Officer and Contracting Officer Representative, will be provided at the time of award

2.05 SHIPPING AND DELIVERY

A. Deliver shipments to the following address:
- Hoover Dam Central Warehouse
- NV State Route 172
- Boulder City, NV 89004
- ATTN: [name of the COR]

B. Receiving hours are 0730-1530 PST, Monday through Friday, excluding Federal holidays.

C. Notify the COR of inbound shipments at least two business days prior to anticipated delivery date.

D. Ship only via freight carriers which possess fleets of sufficient size to ensure the shipment is delayed not more than two days due to breakdown, vehicle or driver unavailability, or any other circumstances, excluding inclement weather.

E. If the vehicle transporting material is involved in an accident and a reasonable person would consider it prudent to inspect the material for damage before use at Hoover Dam, the Contractor shall arrange for the material to be transported to its shop and inspect the material completely before reshipment to Hoover Dam.

2.06 RECEIVING

A. The Government will accept shipments on behalf of the Contractor at the Hoover Dam Central Warehouse during normal business hours.
1. The Government will not inspect shipments which are accepted on behalf of the Contractor. The Contractor is responsible for inspection of shipments for any damage incurred in transit.
2. The Government will not transport shipments. The Contractor is responsible for the

transportation of shipments from the Hoover Dam Central Warehouse to the worksite.

2.07 SHOP ACCESS

A. If specified in the SOW, the Contractor shall permit the Government access to any facilities where the Contractor is executing work under this contract or is storing material which will be used under this contract at any time when work under this contract is being executed.

2.08 SUBMITTAL ITEMS

A. RSN A-1, Payment Information

1. Information for payment of invoices by Electronic Funds Transfer.

B. RSN A-2, Project Schedules

1. The total project schedule, using Critical Path Method (CPM) techniques and a logic diagram and bar chart showing the major items of work contained in the proposal, their durations, and anticipated start and finish dates. The schedule should show float, material, manpower (shifts and days per week), equipment resources, major submittals required, and the logical relations or interface between activities.

C. RSN 001, Extended Warranty

1. Extended Warranty as required in Section 6.01.

D. RSN 002, Approval Drawings and Design Data

1. Hill chart for A2 and N7.
2. Detailed drawings of the runner including fabrication details and blade shape, runner cone, coupling bolts, seal rings, and material limits and locations for balancing.
3. Provide the following design data as part of this submittal item.
   a. Weight of runner, cone and seal rings.
   b. Materials list for runner crown, blades, band, and cone including the chemical composition of all runner components.
   c. Materials list and assembly details for turbine runner to turbine shaft coupling bolts.
   d. Design clearances between rotating seal surfaces on turbine runner and stationary seal rings. Stepped labyrinth seals shall not be used for the turbine runner or stationary seal design. Grooved stationary seal ring design will be allowed, but any modifications to the original design will require review from the COR.
   e. Wear ring interference calculations.
   f. Maximum downward thrust – both with design seal ring clearances and with 2x design seal ring clearances.
   g. Maximum upthrust – both with design seal ring clearances and with 2x design seal

ring clearances.

h. Maximum sustained runaway speed at 565 feet of head, various gate positions.

i. Provide transient analysis results, including wicket gate timing as part of this submittal.

i. Moment of inertia (WR_2) of the runner both watered and un-watered.

j. Design calculations and complete information showing the maximum unit stresses used in the design.

k. Operating range for the unit.

4. Inspection plan detailing nondestructive test methods contractor will use for locating casting defects and weld defects of the runner components and fabricated runner and methods to measure Dimensional check of the runner.

   a. Inspection requirements are described in section 3.05.

5. Heat treatment procedure.

6. Runner balancing procedure.

7. Fatigue analysis.

8. Efficiency and power characteristics.

9. Cavitation repair procedures including recommended weld rod materials, preparation, weld procedures, post-weld heat treatment, and template locating drawings.

10. Drawings showing the dimensions and positioning of runner blade inlet edge templates and runner blade discharge edge templates.

11. Drawings showing the design and location of the roughening air admission system and all related components.

E. RSN 003, Runner Fabrication Logistics

1. Casting, plate, forging, and fabrication locations.

2. Transportation information.

F. RSN 004, Runner Material Certification

1. Provide certifications for all materials to be used for the turbine runner and associated equipment.

   a. Requirements for material certifications are defined in section 4.01.E.

G. RSN 005, Casting Inspection Reports

1. Reports of NDT of all castings to be used for fabricating the turbine runner and associated

equipment prior to assembly.

a. Government approval is required before contractor may begin repair welding.

b. Refer to sections 3.05 and 4.02.C for more details.

H. RSN 006, Initial Dimensional check Inspection Reports

1. Report of the turbine runner Dimensional check after tack welding and trial assembly.

a. Government approval is required before contractor may adjust/relocate components.

b. Refer to sections 3.05 and 4.05.D for more details.

I. RSN 007, Welding Inspection Reports

1. Reports of NDE/NDT of welds made to assembly the turbine runner crown, band, and blades. Inspections shall also include regions affected by the heat during the weld process.

a. Government approval is required before contractor makes repairs to the welds or components with heat affected surfaces.

b. Refer to sections 3.05 and 4.06.G for more details.

J. RSN 008, Balancing Report

1. Final report of runner balancing once assembly is complete.

a. Include in the report a description of changes made and drawings that include the location of balance modifications.

b. Include results from final balance test and the balance quality achieved for government review.

c. Refer to section 4.08 for more details.

K. RSN 009, Final NDT and Dimensional Check Report

1. Final NDT report after assembly and final machining.

a. Refer to sections 3.05 and 4.05.E for final NDT requirements.

2. Final dimensional check inspection report after assembly and final machining.

a. Refer to sections 3.05 and 4.05.D for final dimensional check requirements.

L. RSN 010, Runner Final Data

1. As-built drawings with final runner dimensions and machined weight.

2. Templates and drawings for runner repair as per section 4.03.

a. Submit drawings showing positioning of the templates for reference.

3. As-built drawings with final seal ring dimensions and upstream/downstream and

river/canyon clearances.

4. All drawings provided within this submittal shall become property of the government.

M. RSN 011, Seal Ring Material Certification

1. Provide certifications of seal ring materials for government review.
   a. Refer to section 5.03.A for material requirements.
   b. Provide heat treatment procedure, furnace type, and controls for seal rings as part of this submittal.
   c. Any material found unsatisfactory will require replacement. Refer to section 4.01.G if specified materials are unavailable.

N. RSN 012, Runner to Shaft Coupling Stud and Nut Design Data

1. Provide design drawings or product information for coupling studs and nuts that meet the requirements listed in sections 5.01 and 4.01.B.

O. RSN 013, Associated Equipment As-Built Drawings

1. Provide as-built drawings of the following components:
   a. Stationary seal rings machining with final dimensions.
   b. Roughing air admission system components:
      i. Air admission piping for the turbine pit, headcover, and turbine runner.
      ii. Turbine shaft cap.
      iii. Air admission support cone.
2. All drawings provided within this submittal shall become property of the government.

P. RSN A-3, Release of Claims Release of Claims (DI-137) against the United States

1. Release of Claims (DI-137) against the United States.

2.09 LIST OF SUBMITTALS

A. Table 1-List of Submittals

RSN	Item	Primary POC	Submittals required	No. of sets to be sent to:		Due Date or delivery time
				CO	COR	
A-1	Payment Information	CO	Information for payment of invoices by Electronic Funds Transfer. Ensure payment data in System for Award Management database is current, accurate, and complete.	1	1	14 days prior to first payment.

A-2	Project Schedule	CO	Project baseline schedule updated once per month with actual progress. The initial schedule must be accepted by the Government prior to the start of work.	1	1	Baseline schedule submittal within 30 days of contract award
A-3	Performance and Payment Bonds	CO	Within 14 days of award	2	0	Prior to issue of Notice to Proceed
A-4	Release of Claims	CO	Release of Claims (DI-137) Against the United States	1	0	After completion of the work and prior to final payment
001	Extended Warranty	CO	Refer to requirements in 6.01.	2	2	Within 30 days of contract award
002	Approval Drawings and Design Data	COR	Provide all relevant design data and information as per Section 3	2	2	Within 270 days of contract award
003	Runner Fabrication Logistics	COR	Provide logistics for runner component fabrication as described in section 4.01.D.	1	2	Within 60 days prior to casting or fabrication of components
004	Runner Material Certification	COR	Provide material certifications for all materials used for the turbine runner and associated equipment. Refer to section 4.01.E for more details.	1	2	Within 7 days of receipt of materials
005	Casting Inspection Reports	COR	Provide an inspection report for all cast materials. Refer to sections 3.05, and 4.02.C for more details.	1	2	Within 14 days of receipt of cast materials
006	Initial Dimensional Check Inspection Reports	COR	Provide a report on the turbine runner dimensional check in trial assembly. Refer to sections 3.05 and 4.05.D for more details.	1	2	Within 5 days of tack welding and trial assembly of the turbine runner
007	Welding Inspection Reports	COR	Provide a report on all inspections performed on assembly welds. Refer to sections 3.05 and 4.06.G for more details.	1	2	Within 14 days of completing welding and assembly of the turbine runner.
008	Balancing Report	COR	Provide a report on the final balance and modifications	1	2	Within 7 days of completing balancing.

			made to achieve balance. Refer to section 4.08 for more details.			
009	Final NDT and Dimensional Check Report	COR	Provide an inspection report of the final inspections performed on the runner prior to delivery. Refer to sections 3.05, 4.05.D, and 4.05.E for more details.	2	2	Within 30 days of completing assembly, machining, and balancing.
010	Runner Final Data	COR	Provide drawings and design data as per section 3, including all machining and adjustments made after assembly, templates for runner repair as described in section 4.03, and details on balancing as per section 4.08.	2	2	7 days prior to planned shipment of runner
011	Seal Ring Material Certification	COR	Provide certification for the materials listed in section 5.03 in addition to seal ring heat treatment logistics.	1	2	Within 7 days of receipt of materials
012	Coupling Nut Design Data	COR	Provide information on coupling nut design selection. Requirements are described in sections 5.01 and 4.01.B	1	2	Within 14 days prior to purchase/fabrication of coupling nuts
013	Associated Equipment As-Built Drawings	COR	Provide as-built drawings of the stationary seal rings machining with final dimensions, roughing air admission piping (both in the turbine pit/headcover and turbine runner), shaft cap, and support cone.	1	1	Within 28 days of completing final stationary seal ring machining and installation of air admission system.
A-3	Release of Claims Against the Government	CO	Release of Claims (DI-137) against the United States	1	0	After completion of the work and prior to final payment.

SECTION 3 - RUNNER DESIGN AND ANALYSIS

3.01 REFERENCE STANDARDS

A. Unless otherwise specified, all materials that will become a part of the completed work shall be new and will conform to the following standards and be of standard commercial quality.

B. American Society of Mechanical Engineers (ASME)

1. ASME B46.1-2019 Surface Texture (Surface Roughness, Waviness, and Lay)
2. ASME BPVC-2025 Boiler and Pressure Vessel Code
3. ASME PTC 18-20 Hydraulic Turbines and Pump-Turbine Performance Test Codes
4. ASME Y14.1-2020 Drawing Sheet Size and Format
5. ASME Y14.5-2018 (R2024) Geometric Dimension and Tolerancing

C. American Society for Testing and Materials International (ASTM International)

1. ASTM A193/A193M-25 Standard Specification for Alloy-Steel and Stainless-Steel Bolting for High Temperature or High-Pressure Service and Other Special Purpose Applications
2. ASTM A240/A240M-25a Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
3. ASTM A743/A743M-21 Standard Specification for Castings, Iron-Chromium, Iron-Chromium-Nickel, Corrosion Resistant, for General Application
4. ASTM A751 Test Methods and Practices for Chemical Analysis of Steel Products
5. ASTM A802-19 Standard Practice for Steel Castings, Surface Acceptance Standards, Visual Examination
6. ASTM A903/A903M-99(2024) Standard Specification for Steel Castings, Surface Acceptance Standards, Magnetic Particle and Liquid Penetrant Inspection
7. ASTM A967/A967M-25 Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts
8. ASTM E164-24 Standard Practice for Contact Ultrasonic Testing of Weldments
9. ASTM E165/E165M-18 Standard Practice for Liquid Penetrant Testing for General Industry
10. ASTM E1742/E1742M-23 Standard Practice for Radiographic Examination
11. ASTM E186-20 Standard Reference Radiographs for Heavy-Walled (2 to 4 1/2 in. (50.8 to 114 mm)) Steel Castings
12. ASTM E280-21 Standard Reference Radiographs for Heavy-Walled (4 1/2 to 12 in. (114 to 305 mm)) Steel Castings
13. ASTM E390-20 Standard Reference Radiographs for Steel Fusion Welds
14. ASTM E446-20 Standard Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm)

in Thickness

15. ASTM E709-21 Standard Guide for Magnetic Particle Testing

D. International Electrotechnical Commission (IEC)

1. IEC 60193 (2019) Hydraulic turbines, storage pumps, and pump-turbines – Model acceptance tests

E. American Welding Society (AWS)

1. AWS D1.1/D1.1M:2020 Structural Welding Code - Steel
2. AWS D1.6/D1.6M-2017 Structural Welding Code - Stainless Steel

F. Cahier Des Charge (CCH)

1. CCH 70-4 (2014) Inspection of Steel Castings of Hydraulic Machines

3.02 CURRENT UNIT RATING AND DATA

A. General

1. The original turbines are vertical-shaft Francis-type and were installed between 1935 and 1941 by the Baldwin-Lima-Hamilton, Co.
2. The replacement runners for A2 and N7 were supplied by Voest-Alpine Int Corp under specifications DS-7403, awarded January 1980 and installed in 1989 (A2) and 1982 (N7).
3. Existing turbine output for units A2 and N7 with current wicket gates and 9.7" GVO is 157,300 hp at 490 feet, full gate.
4. The Nevada unit N7 rotates at 180 revs/min, clockwise, viewed from above.
5. The Arizona unit A2 rotates at 180 revs/min, counterclockwise, viewed from above.
6. The Hoover generators installed at Units N7 and A2 are currently rated at 133.3 MVA each.

B. Rough Zone

1. Rough zones currently occur at gate openings 25% to 80%.

C. Air Depression System

1. Units A2 and N7 use a system to admit compressed air to the draft tube to depress the water level in the turbine to reduce electrical load during condenser operation.

D. The effective head range on the turbine for power production may vary between 350 and 575 feet. The expected range is 396 feet to 511 feet net head. The controlling water-surface elevations are as follows:

E. Table 2- Turbine operating conditions

Location		Elevation (feet)
Tailwater	Minimum	630

	Normal Range	639 – 656
Headwater	Minimum for generation	1000
	Maximum for generation	1229
Casing Centerline		637

3.03 UNIT STRESSES AND FATIGUE ANALYSIS

A. Ensure that the turbine runner and associated components provided under this solicitation adhere to the same safety factors used for units A1, N5, N6, and N8.

B. Provide the COR, upon request, a copy of each mill or shop order for material purchased by the Contractor for use in the fabrication of turbine components.

1. The copies of the orders shall state the place at which the material is to be manufactured.
2. All such mill or shop orders shall quote the requirements of the special conditions and drawings for articles, materials, and supplies to be furnished.

C. Perform fatigue analysis on units A2 and N7 using the following conditions:

1. The units rotate at 180 rpm, clockwise, viewed from above.
2. Unit runaway speed: 340 rpm.
3. Unit Cycles:
   a. Number of starts/stops per year: 400.
   b. Runaway: 1 time per year.
   c. Load rejection: 1 time per year.
   d. Unit is under Automatic Generation Control and experiences continuous load adjustments when online.
   e. Load changes; 40 load changes per day from SNL to 100% wicket gate opening is typical.
   f. The unit operates in condense for a maximum of 500 hours a month, 67% of the year.
4. Ensure that fatigue analysis shows the turbine runners are capable of a lifespan of 50 years or more.

D. As per RSN 002 perform CFD/FEA as needed to provide the following guaranteed points:

1. The guaranteed points below will be used for performance testing after runners are

installed.

a. Peak efficiency at 400 feet net head.
b. Full gate efficiency at 400 feet net head.
c. Full gate power at net head of 400 feet net head.

2. The characteristics from this section will be considered warrantied characteristics and covered under FAR clause WBR 1452.246-81, Failure to Meet Performance Warranties.

E. In the hill charts for A2 and N7 provided as per RSN 002 detail cavitation-free zones and rough zone magnitudes at various heads.

3.04 DESIGN AND PERFORMANCE REQUIREMENTS

A. Manufacture and deliver two turbine runners using the design provided to the Hoover Dam for units A1, N5, N6, and N8.

B. The first runner, for Unit A2, shall use the counterclockwise design from A1. The second runner, for Unit N7, shall use the clockwise design from N5, N6, and N8.

3.05 NON-DESTRUCTIVE TESTING AND INSPECTIONS

A. Inspection Plan:

1. As per RSN 002, provide a plan for inspections including the following:
   a. Examination type to be used for each given situation.
   b. Equipment to be used for examinations and inspections that meets standards for each method being used. For dimensional checks, describe measurement equipment and accuracy of instrumentation to be used.
   c. Details and qualifications of inspection personnel for each examination type to be used.
   d. Procedure of inspections and reference standard to be used by the contractor
   e. Procedure and details of weld repairs.
      i. Include details such as the filler material to be used for certain components and the pre-post heat procedure within the plan.
   f. Procedure of component locational adjustment in the case of a failed dimensional check.

B. Personnel Qualifications:

1. Qualified in accordance with the relevant reference standard for the examination type.
2. The minimum qualification level of all NDT personnel shall be Level II for the specific

examination type being used.

a. Personnel must have at least 5 years of experience as a Level II.

b. For UT and RT, inspection reports shall be reviewed and signed by someone of Qualification Level III for UT and/or RT respectively.

C. Equipment Requirements:

1. Provide the necessary equipment and tools to perform adequate NDT on the runner and associated equipment.

   a. Equipment must meet standards as applicable for each inspection method.

2. Provide templates and other means, such as 5-axis measuring machinery or templates, to compare dimensions of the runner to drawings to check dimensions.

D. VT, MT, and PT Requirements:

1. VT in accordance with CCH 70-4 and ASTM A802.

   a. VT on cast components in accordance with ASTM A802.

   b. Unless otherwise stated, VT alone will not be sufficient for an inspection and must be performed in addition to another examination method.

2. MT in accordance with ASTM E709.

   a. MT on cast components in accordance with both ASTM E709 and A903.

3. PT performed in accordance with ASTM E165.

   a. PT on cast components in accordance with both ASTM E165 and A903.

E. RT Requirements:

1. Perform RT in accordance with Section V of the ASME BPVC and the following ASTM standards for cast components:

   a. ASTM E446 for all castings up to 2 inches in thickness.

   b. ASTM E186 for all castings 2 to 4.5 inches in thickness.

   c. ASTM E280 for all castings 4.5 to 12 inches in thickness.

      i. Components that are 4.5 inches in thickness shall be inspected in accordance with ASTM E280.

2. RT on welds performed in accordance with ASTM E390.

3. For all other components, RT performed in accordance with ASTM E1742.

4. Contractor may use any radiation source listed in the relevant ASTM standard, so long as

they specify in the inspection plan what source will be used.

F. UT Requirements:

1. UT on welds shall be in accordance with ASTM E164.
2. UT on other components in accordance with ASTM A609.
3. Note that UT may be used on cast components to determine if a defect has been totally removed during excavation but cannot be used as the primary defect inspection method.

G. Dimensional Checks:

1. Provide dimensional measurements of the turbine runner and compare them to the dimensions in the design drawings.

H. Inspection Reporting:

1. Report all defects with clear defect mapping that indicates the location, size, and depth of all defects.
2. Provide photos of defects and include images in inspection reports.
    a. Photos to the requirements described within section 2.02.F.
    b. Photos to include a scale for relative size of defect and location of defect.
3. For dimensional checks, contractor shall provide annotated drawings showing the as found measurements taken during the inspection and a copy of the design drawings with dimensions and tolerances that were compared.
    a. If adjustments were required to pass the dimensional check, include in the report indications of which components needed to be adjusted and dimensions before and after said adjustments.

I. Acceptance Criteria:

1. Refer to Table 3A for runner blades, band, crown, band, and welds acceptance criteria.
2. Refer to Table 3B for all other components (bolts, seal rings, etc.) acceptance criteria.
    a. For Table 3A and 3B, critical locations shall refer to the following areas:
        i. Welds joining the runner blade to the curb/band and crown, including the area within 2 inches beyond the weld of all surfaces.
        ii. Leading and trailing edges of the runner blades.
        iii. Any location that experiences more than 1/3 of the material yield strength during regular operation as determined by FEA.
3. Dimensional check Criteria:
    a. To pass the dimensional check, all measurements must be accurate to the contractor

drawings with all the dimensions within design tolerances.

4. Base acceptance criteria on whatever measurement/value is the smallest.

J. Table 3A – Acceptance Criteria for Runner Blades, Band, Crown, Band, And Welds.

Method	Critical Locations	All Other Locations
VT	As per ASTM A802, cast surface discontinuities shall have an Acceptance Level of A1, B1, C2, D1, E3, F1, G1, H1, and J1. For non-cast components any cracks or cavities exceeding 10 percent of the material thickness or 0.5 inches will not be accepted.	As per ASTM A802, discontinuities of cast surfaces shall have an Acceptance Level of A2, B2, C1, D1, E3, F1, G2, H3, and J2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.
PT	As per ASTM A903, cast components shall be inspected to Acceptance Level 1. For non-cast components any cracks or cavities exceeding 10 percent of the material thickness or 0.5 inches will not be accepted.	As per ASTM A903, cast components shall be inspected to Acceptance Level 2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.
MT	As per ASTM A903, cast components shall be inspected to Acceptance Level 1. For non-cast components any cracks or cavities exceeding 10 percent of the material thickness or 0.5 inches will not be accepted.	As per ASTM A903, cast components shall be inspected to Acceptance Level 2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.
UT	Cavities or voids shall be held to an acceptance of CCH70-4 quality level 1 for their given thickness. .	Cavities or voids shall be held to an acceptance of CCH70-4 quality level 2 for their given thickness.
RT	Using the appropriate ASTM standard, cast surfaces with any discontinuity above severity level 1 will not be accepted.	Using the appropriate ASTM standard, cast surfaces with any discontinuity above severity level 2 will not be accepted.

K. Table 3B – Acceptance Criteria for All Other Components

Method	Critical Locations	All Other Locations
VT	As per ASTM A802, discontinuities of cast surfaces shall have an Acceptance Level of A2, B2, C1, D1, E3, F1, G2, H3, and J2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.	As per ASTM A802, discontinuities of cast surfaces shall have an Acceptance Level of A3, B4, C3, D2, E3, F1, G3, H4, and J3. For non-cast components, any cracks or cavities exceeding 20 percent of the material thickness or 1 inch will not be accepted.
PT	As per ASTM A903, cast surfaces shall be inspected to Acceptance Level 2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.	As per ASTM A903, cast surfaces shall be inspected to Acceptance Level 3. For non-cast components, any cracks or cavities exceeding 20 percent of the material thickness or 1 inch will not be accepted.
MT	As per ASTM A903, cast surfaces shall be inspected to Acceptance Level 2. For non-cast components any cracks or cavities exceeding 15 percent of the material thickness or 0.75 inches will not be accepted.	As per ASTM A903, cast surfaces shall be inspected to Acceptance Level 3. For non-cast components, any cracks or cavities exceeding 20 percent of the material thickness or 1 inch will not be accepted.

UT	Cavities or voids shall be held to an acceptance of CCH70-4 quality level 1 for their given thickness. .	Cavities or voids shall be held to an acceptance of CCH70-4 quality level 2 for their given thickness.
RT	Using the appropriate ASTM standard, cast surfaces with any discontinuity above severity level 2 will not be accepted.	Using the appropriate ASTM standard, cast surfaces with any discontinuity above severity level 3 will not be accepted.

L. Government Witness Inspections

1. Conduct final NDT and dimensional check inspection of the runner with the COR present at a location that is approved for travel by the Department of State (www.travel.state.gov) without additional protective services or safety requirements.
   a. If the runner fabrication and inspection location does not meet these requirements, relocate the runner to a machine within the United States, for final inspection.
   b. Perform both the final NDT and dimensional check inspections within the same time period to be witnessed and examined by the Government during one visit. A report of inspections results as part of RSN 009 is still required.
2. Provide 30-days notice for domestic witness inspections and 60-days notice for international witness inspections.

3.06 PERFORMANCE TESTING

A. Performance testing will be performed on both units. The government will be responsible for data collection and evaluation. The contractor shall provide an engineer to witness testing.

1. Performance testing must be performed no later than 2 years of the runner being put into service.

B. Per ASME PTC 18. Testing to be conducted within two years of when the units are placed into service.

C. Performance will be evaluated using the final hill chart from the most recent turbine runner the new units are based upon.

1. To pass performance testing each tested unit must meet the efficiency as defined within the hill chart in accordance with ASME PTC 18.
2. Test uncertainty of +/- 0.75 percent.
3. Test head within +/-4 percent of a net head of 400 feet.

D. If the tested unit(s) do not produce the efficiency as guaranteed the contract price will be adjusted in accordance with the clause at WBR 1452.246-81, Failure to Meet Performance Warranties.

SECTION 4 - RUNNER MANUFACTURING

Turbine Runner (ref. Dwg. No. 42335, 42343, 42344, 42345, 42390, 42393)

4.01 MATERIAL REQUIREMENTS

A. Turbine runner components materials:
   1. Runner: ASTM A743 grade CF-3 cast components including supplemental requirements S3 through S7 and S12.
   2. Nose cone: ASTM A240 UNS S30403/304L stainless steel plate.
   3. Integral Seal Rings: Same material as used for the turbine runner crown and band.

B. Unless otherwise specified, materials used in the manufacturing of the equipment shall conform to applicable specifications of ASTM, SAE, or ANSI.

C. Submit to the COR, per RSN 003, fabrication logistics including the following:
   1. Casting, plate, forging, and fabrication locations.
   2. Transportation information.

D. Submit to the COR, per RSN 004, material certifications for all materials including the following:
   1. Chemical composition of materials determined by ladle analysis.
   2. Mill Test Report detailing the physical properties of the material:
      a. Ultimate Tensile Strength in KSI.
      b. 0.2% Yield in KSI.
      c. Percent elongation in 2 inches.
      d. Brinell hardness.
      e. Records of method used to determine physical properties.
   3. Heat treatment records.

E. Show the chemical composition of components in their respective drawings.

F. Procure the specified materials. If the specified materials are unavailable, substitute materials shall only be permitted with written approval from the Government.
   1. Any substitution shall be equal to or better than the material specified. The contractor shall prove that the proposed substitute material is equal to or better than the material specified.
   2. Substitute materials will be reviewed by the COR and CO prior to approval, and the CO may accept or reject any proposed material substitution at their discretion.

4.02 CASTING

A. Furnish to the COR certificates showing the results of the ladle analysis and material properties as per ASTM A751. See RSN 004 in Table 1 – List of Submittals.
   1. The COR will compare the material composition results from the ladle analysis to the

material standard for ASTM A743 Grade CF-3. If any element in the material composition is outside of acceptable range for A743 Grade CF-3 the material will be rejected.

B. Heat-treating procedure as recommended by the contractor in accordance with ASTM A743 and approved by the COR. See RSN 002 in Table 1 – List of Submittals.

C. Perform NDT on all cast components prior to assembly in accordance with section 3.05.

1. Any defect or discontinuity found that does not meet the acceptance criteria defined in section 3.05.I and Tables 3A and 3B must be repaired by the contractor.
    a. If any casting has more than 5 defects that fail acceptance the entire casting shall be rejected, and contractor must furnish a new casting.
        i. The new casting shall be subject to the same inspection criteria.
    b. Contractor must first notify the COR and await approval to begin any repairs.
        i. Include in the correspondence the extent of defect excavation prior to repair welding.
    c. If excavation is required to properly repair a defect, contractor must use PT or MT in accordance with section 3.05.E to ensure the defect is entirely removed.
    d. Ensure repairs do not reduce the base metal below the design thickness.
    e. After repairing the defect contractor shall refinish repaired regions to meet the requirements in section 4.07.
    f. After repairs are complete, contractor must repeat NDT on component to ensure all defects have been repaired and no new defects are present.
2. As per RSN 005, contractor shall provide a report of results from the NDT in accordance with section 3.05.H.
3. All inspections and repairs shall be done at the expense of the contractor.

4.03 RUNNER BLADE TEMPLATES

A. As per RSN 010, fabricate and furnish four templates to fit the profile of the runner blade, spaced evenly across the discharge edge, and three templates to fit the profile of the runner blade, spaced evenly across the inlet edge, to aid in runner repair per IEC 60193.

1. Use templates to validate final hydraulic profile.
2. Design all templates for use in the field.

B. Laser-cut to match profile in designated locations, considering allowable tolerances.

C. Stamp to identify relative locations to leading and trailing edges, pressure or suction side and

template elevation.

D. Deliver templates along with the turbine runner, coupling nuts, or seal rings to the government.

E. Contractor shall provide a rigid storage case with lockable latches and foam interior with cut-outs to secure templates.

1. Clearly label case with project name, unit, contents, and weight.

4.04 INTEGRAL SEAL RINGS

A. Provide turbine runner with integral upper and lower rotating seal rings as per the design used for A1, N5, N6, and N8.

1. Machine and finish the turbine runner's integrated rotating seal rings.
    a. Refer to section 4.07.A.3 for requirements on seal ring surface finish.
2. Ensure the seal rings have sufficient base material to allow for seal rehabilitation in the future.
3. Measure the rotating seal diameters of the turbine runner which interfaces with the stationary surfaces.

B. Determine target diameters for each surface and submit the targets to the COR for review before any material is removed.

4.05 ASSEMBLY

A. Assemble runner of major components welded together.

1. The band, crown, and blades are considered major components.
2. Details on welding requirements are provided in Section 4.06.

B. Cast the crown, band, and buckets or fabricate using stainless steel plate.

C. Perform shaping of the buckets prior to welding between the crown and band by machining using a numerically controlled 5-axis milling machine or by stamping plate material.

D. Perform dimensional check inspections on the turbine runner in accordance with Section 3.05.H.

1. Any dimensions found during a dimensional check inspection that does not meet the acceptance criteria defined in Section 3.05.I.3. must be adjusted by the contractor.
2. Contractor must first notify the COR and await approval to begin any adjustments.
    a. After making necessary adjustments contractor shall reperform dimensional check inspections to ensure dimensions are in tolerance.
    b. Regions where tack welds had to be removed and reapplied for adjustments shall

have NDT performed to ensure no defects formed during the process.

i. Refer to Section 4.06.G for weld inspection guidelines.

3. Dimensional check inspections shall be performed at the following intervals:
   a. Initial dimensional check: Perform inspection with all components positioned in trial assembly and tack welded together.
   b. Final dimensional check: Perform inspection after assembly, machining, and balancing of the runner is complete and RSN 001 through 008 are submitted and approved.
      i. Final dimensional check inspection shall be performed with a government witness. Refer to Section 3.05.J for more details.
4. As per RSN 006, provide a report of results from the initial dimensional check inspection in accordance with Section 3.05.H.
5. As per RSN 009, provide a report of results from the final dimensional check inspection in accordance with Section 3.05.H.
6. All inspections and adjustments shall be made at the expense of the contractor.

E. Perform final NDT in accordance with Section 3.05 on the turbine runner after assembly, machining, and balancing of the runner is complete and RSN 001 through 008 are submitted and approved.

1. This inspection shall be conducted with a government witness. Refer to Section 3.05.J for more details.
2. Any defect or discontinuity found that does not meet the acceptance criteria defined in Section 3.05.I and Tables 3A and 3B must be repaired by the contractor.
   a. Contractor must first notify the COR and await approval to begin any repairs.
      i. Include in the correspondence the extent of defect excavation prior to repair welding.
   b. If excavation is required to properly repair a defect, contractor must use PT or MT in accordance with Section 3.05.F to ensure the defect is entirely removed.
   c. Ensure repairs do not reduce the base metal below the design thickness.
   d. After repairing the defect contractor shall refinish repaired regions to meet the requirements in Section 4.07.
   e. After repairs are complete, contractor must repeat NDT on components to ensure all defects have been repaired and no new defects are present.
3. As per RSN 009, provide a report of results from the final NDT in accordance with Section

3.05.H.

4. All inspections and repairs shall be done at the expense of the contractor.

F. Perform trial assembly on runner and runner cone (if applicable) prior to shipment to Government to ensure there is a smooth transition between the crown and nose cone.

4.06 WELDING

A. Perform welding by the electric-arc method by a process that excludes the atmosphere from the molten metal, and where practicable, by automatic machines.

B. All welding work shall be done in accordance with AWS D1.1 and D1.6 where applicable.

C. Welding qualifications

1. Welding operators and procedures must be in accordance with Section IX of ASME BPVC.

D. Begin the assembly process with tack welding the turbine runner components after submittal and approval of RSN 001 to 005.

E. Submit RSN 006 and receive approval before continuing runner assembly welding.

F. Machined surfaces of parts affected by welding shall be machined to final dimensions after welding is complete.

1. In addition, grind and fair weld passes smooth to the specified surface finish as per section 4.07.

G. Design and fabricate welded parts subject to stress from hydraulic pressure and other principal stress-carrying parts in accordance with Part UW of ASME BPVC-VIII, with the following exceptions:

1. Localized stress-relieving is not permitted for shop-welded parts.
2. Where required under ASME BPVC-VIII or under this solicitation, welded joints inspected by a non-destructive method approved by the Government.

H. Perform NDT on welds and heat affected zones in accordance with Section 3.05.

1. Inspections shall be performed at the following intervals:
   a. After fillet welding and initial arc gouging weld ends.
   b. After bucket end welding is complete.
   c. After welding and contouring are complete.
2. Any defect or discontinuity found that does not meet the acceptance criteria defined in Section 3.05.I and Tables 3A and 3B at each inspection interval must be repaired by the contractor.
   a. Contractor must first notify the COR and await approval to begin any repairs.
      i. Include in the correspondence the extent of defect excavation prior to repair

welding.

b. Ensure repairs do not reduce the base metal below the design thickness.

c. After repairs are complete contractor shall repeat the specified NDT on the welds and surrounding area to ensure the defects have been repaired and no more defects are present.

d. After repair contractor must ensure they refinish the repaired area to meet the specified finish requirements in Section 4.07.

3. As per RSN 007, provide a report of results from NDT on welds in accordance with Section 3.05.H.

4. All inspections and repairs shall be done at the expense of the contractor.

4.07 FINISHING AND TRAILING EDGES

A. Surfaces in contact with water, including weld surfaces, must be machined or ground smooth to prevent hollows, depressions, cracks, and projections that may lead to cavitation or pitting:

1. The intake and discharge end of the blades and the band must have a max Ra of 63 micro-inches.

a. The intake end will be considered as 1/3 of the surface area of both the high- and low-pressure sides of every runner blade from the leading edge.

b. The discharge end will be considered as 1/3 of the surface area of both the high- and low-pressure sides of every runner blade from the trailing edge.

c. The leading and trailing edges of each bucket shall also have a max Ra of 63 micro-inches.

2. All other flow surfaces shall have a max Ra of 125 micro inches.

a. Seal and seal rings shall have a max Ra of 63 micro inches.

b. All other non-hydraulic surfaces shall have a max Ra of 250 micro inches.

3. Runner blade profiles shall conform to IEC 60193 standards for waviness requirements.

4. Ensure the final thickness of all trailing edges in the as-built drawings include the machining of surfaces and grinding and fairing of welds.

a. In addition, ensure the final thickness values match the minimum thickness values used in the FEA models of units A1, N5, N6 and N8.

4.08 BALANCING

A. Submit RSN 001 through 007 prior to balancing the turbine runner.

B. Statically balance the assembled runner in accordance with ISO 1940/1 and with a balance quality

of G6.3.

C. Balance by removing weight from the balance pad and document the location of all material removed for balance correction.

D. If contractor are unable to balance the runner by removing material from the balance pad alone, with CO approval contractor may balance by 1st adding weight and 2nd removing weight from a water passage surface.

1. If material addition is required, it must only be located on the balance pad and material added must not interfere with the throat ring or draft tube liner of the unit.
2. If material removal from a water passage surface is required, the diameter of the removal must be at least 100 times its depth, and the surface finish must be restored to the specified finish in Section 4.07.
    a. The depth of the material removal is not to exceed 0.0625 inches.

E. As per RSN 008 provide a final balance report on the turbine runner:

1. The balance report should detail the balance of the turbine after all machining and balancing actions and showcase the runner has met the balance quality requirement.

F. Include drawings detailing the method of weight adjustment as per RSN 008.

G. Note that the final balancing will not require government witness but will require a report of balance test results for review and approval.

4.09 CLEANING AND PASSIVATING

A. Shop Cleaning and Protective Coating:

1. All cleaning and passivating in accordance with ASTM A967-25.
2. Contractor must first submit and receive approval of RSN 001 through 009 before cleaning and passivating may begin.
3. Perform the following on stainless steel equipment:
    a. Pre-clean, descale, and clean to remove all grease, oil, paint, flux, weld spatter, slag, burrs, scale corrosion products, foreign metals, and other surface contaminants. Passivate entire runner after cleaning as above.
    b. Perform copper sulfate test or another approved method listed in ASTM A967-25 to detect if any free surface iron is present.
4. Use cleaning and passivating methods consistent with specified surface finish, part size, and alloy material.
5. Protect surfaces as necessary to preserve finish until installed.
6. Clean and coat other finished surfaces of ferrous metalwork, including screw threads,

exposed to the atmosphere during shipment with corrosion-preventive compound.

B. Post passivation:

1. Provide litmus test to ensure passivation process is successful.
2. Test random locations on each runner blade, crown, and band per below and provide results. If results do not pass the test, repeat passivation process.
    a. Blade suction side of hydraulic profile: 2 locations per blade.
    b. Blade pressure side of hydraulic profile: 2 locations per blade.
    c. Band, hydraulic side: 5 locations.
    d. Crown, hydraulic side: 5 locations.

SECTION 5 - ASSOCIATED EQUIPMENT

5.01 FASTENERS

A. Turbine shaft to runner coupling bolts and nose cone bolts:

1. Furnish new coupling studs and nuts for the runner to shaft coupling.
2. Coupling nut material: ASTM A194 class 8M.
3. Coupling stud material: ASTM A193 grade B8S.
4. Furnish studs with the diameter 1/16-inch oversize.
5. Hone the shaft and runner coupling holes to create a 0-to-0.001-inch clearance fit with the coupling bolts.
    a. Honing work shall be completed within 30 days of bolts delivery onsite.

B. Runner to nose cone coupling bolts and nuts shall use the following materials:

1. Coupling nuts: ASTM A194 grade 8M.
2. Coupling bolts: ASTM A193 grade B8S.
3. Provide the intended fit for the design/selection of bolts coupling the nose cone to the turbine runner as part of RSN 012 for approval.

C. Runner to shaft coupling nuts shall utilize a multi-jack bolting design made of the required material.

D. Prior to shipment to Hoover Dam contractor must submit design data as per RSN 012 for approval.

1. Design data/drawings must include torquing information, detailing required torque and/or bolt stretch/elongation and torquing pattern.
2. Contractors may propose different materials for fasteners with COR approval.
3. Provide information on the multi-jack bolting design or product being selected for use on the runner to shaft coupling.

E. Ensure all fasteners, excluding custom hardware, have markings from the manufacturer for the grade indicating grade, class, type, and other identifying marks in accordance with referenced or applicable standards.

F. Ensure all fasteners provided are not counterfeit or suspected counterfeit.

1. Refer to Appendix A and B for details on counterfeit and suspect listings. Any fasteners that are suspected to be counterfeit will be rejected and need to be re-furnished at the contractor's expense.

G. Provide means to prevent components and fasteners from loosening, such as lock wire or locking washers.

1. Note that weld locks, split lock washers, or coil lock washers will not be accepted for any part of this contract.

No welding to the turbine shaft is permitted.

5.02 TURBINE NAMEPLATE

A. Provide a new nameplate for the new turbine runner with the following information:

1. Contractor name and logo.
2. Type of turbine.
3. Rated turbine power, in horsepower.
4. Rated net head, in feet.
5. Speed, in RPM.
6. Year the runner was built.

B. Refer to drawing 33503 (A2) and 34685 (N7) in Table 4 for nameplate dimensions and finishes.

1. Only use the drawing for dimensional and finish reference. The new nameplate must have updated text with the values and information of the new turbine runner in place of the text on the provided drawing.

5.03 STATIONARY SEAL RINGS

A. Furnish an upper and lower stationary seal ring for A2 and N7 (one upper and one lower for each unit, four total rings) to be the same as used for A1, N5, and N6.

5.04 SEAL RING INSTALL AND MACHINING

A. Perform the following on site at the Hoover Dam for both A2 and N7:

1. Measure the diameter of the upper and lower seal ring seats at both Upstream-Downstream and Canyon-River locations.
2. Determine concentricity of each ring seat to unit center using a stator-to-throat ring single wire alignment check to determine the unit's center.
3. Machine upper and lower seal ring seats within .002 inches total runout from unit center.
   a. Do not exceed .030 inches of diametral material removal unless approved by the COR.
4. Machine the outer diameters of the stationary seal rings to achieve an interference fit between the rings and their respective housings.
5. Install the seal rings in their housings.
6. Provide dowels and holes in the stationary seal rings for anti-rotation.
7. Machine the inside diameter surfaces and holes of the upper and lower stationary seal rings to create a groove for water admission and establish the design clearances between the stationary and rotating seal rings.
8. Government will provide a 60-day notice on when needed onsite for machining work.

B. Refer to drawing 45-301-7592 for details on seal ring machining dimensions, clearances with ring

seats, and grooves for water admission.

C. Submit final machining as-built drawings as per RSN 013.

5.05 ROUGHING AIR ADMISSION

A. Furnish and install the following for units A2 and N7 as part of this solicitation.

1. Piping/hoses leading into the headcover and turbine stuffing box for pressurized air supply and piping from the turbine shaft to the inside of the runner to supply roughing air.
    a. Refer to the following drawings:
        i. 45-301-9909 – Unit A1, N5, and N6 Turbine Air Vents
        ii. 45-301-10527 - A1 Roughening Air Installation Turbine Shaft Machining
        iii. 45-301-10528 - A1 Roughening Air Installation Headcover Machining and Pipe Installation
        iv. 050-1100-060-BOM-Rev00 - Air Admission Components
        v. 050-1100-061-Rev04 - Upper Pipe Air Admission
        vi. 050-1100-062-Rev02 - Lower Pipe Extension Air Admission
2. Holes into the turbine shaft to allow air to enter the turbine runner.
    a. Refer to drawing 45-301-10527.
3. A seal using a 10.216-inch diameter plug inside of the turbine shaft.
    a. Refer to drawing 45-301-10527.
4. A support cone that can be installed in the turbine runner nose cone to resist vibration in the pipework from Section 5.05.A.4.

B. Use the same air admission system as was used for the previous units.

C. The government shall install the support cone and pipework that goes through the nose cone. All other components shall be installed by the contractor.

D. Submit design drawings and data for the air admission system as part of RSN 002.

E. Submit final as-built drawings and data for the air admission system as part of RSN 013, which shall become property of the government.

1. Both drawings sets must include the working pressure and CFMs required for the system.

F. Government will provide a 30-day notice when personnel are needed onsite.

SECTION 6 - ADDITIONAL REQUIREMENTS

6.01 WARRANTY

In addition to warranting turbines in accordance with the clause at FAR 52.246-19- "Warranty of Systems and Equipment Under Performance Specifications or Design Criteria", warrant the runner as follows:

A. Warrant the runner and runner cone against mechanical defects including but not limited to; excessive cavitation and/or pitting, cracks, and mechanical deformities to the runner or contractor provided equipment for a period of 2 years from the date the unit is placed in service.

1. Cavitation or pitting will be considered excessive under the following conditions
    a. Normal Pressure Head Range: When the cavitation damage or pitting depth is found to be greater than one-sixteenth of an inch at any point on any surface within a cavitated area of 8 square inches.
    b. Extended Pressure Head Range: When cavitation damage or pitting depth is found to be greater than one-eighth of an inch at any point on any surface within a cavitated area of 8 square inches.
    c. Erosion or damage by suspended matter in the water and corrosion caused by the chemical composition of the water are not intended to be covered by the Contractor's cavitation warranty.
2. Mechanical deformities shall include the following:
    a. Warps, voids, or deformations in the runner will be considered deformities and must be addressed by the contractor during the duration of the warranty
    b. The Government will consider any dimension found to be greater than or equal to 5% outside of the design tolerance in provided drawings a mechanical deformity.
3. The warranty shall cover cracks on any part of the new turbine runner provided by the contractor in this solicitation, including but not exclusive to welds, base material, and machined/machine finished edges, at any point in the warranty period.

B. Inspections for cavitation, cracks, and mechanical deformities will occur at 6 months, 1 year, and 2 years after the unit is initially put into service.

1. These inspections will be performed by a government engineer. A hydraulic engineer employed by the contractor is invited to join these inspections, the government will provide a 30-day notice on when the inspection will be performed.
2. Inspection methods may include visual inspection, dye penetrant, or any other method detailed within Section 3.05.

C. Correcting Warranted Failure

1. Excessive cavitation, deformities, or any cracks found in an inspection during the warranty

period shall be repaired by the contractor. If repair is not possible, contractor shall replace the damaged part(s).

a. Such repairs or replacements will be done at the contractor's expense.

2. If contractor determines that the removal of the turbine is required for repairs, the government shall remove the turbine and reinstall after repairs and document the costs which shall be reimbursed by the contractor.
3. Minor cavitation, i.e. anything below the severity described in section 6.01.A, will not be considered warranty work under this solicitation.

6.02 DELIVERY, STORAGE AND HANDLING

A. Deliver the turbine runner and associated equipment to the Hoover Dam Warehouse or to the Hoover Dam cableway staging area as directed by the COR after RSN 001 to 010 have been submitted and approved.

B. Take every precaution during loading, transportation, unloading, and storage to protect from corrosion, deformation and other types of damage to the turbine runner and associated equipment. The contractor shall provide all lift point attachments for transfer from the delivery vehicle by use of the cableway crane.

1. Repair any damage that occurs during delivery and handling of the turbine runner and associated equipment. If, at the CO's discretion, a satisfactory repair is not possible, contractor shall replace the damaged part.

C. The Government will store the turbine runner and associated equipment and perform required maintenance during storage in accordance with the manufacturer's recommendations.

D. Item required under this solicitation shall be delivered at the following intervals:

1. The turbine runner shall be delivered after contractor submits and receives approval of RNS 001 through RSN 008.
2. The seal rings and coupling bolts shall be delivered after contractor submits and receives approval of RSN 011 and RSN 012.

6.03 MAINTENANCE

A. Extra Materials

1. Provide and maintain in storage, for at least 10 years after contract completion, free of cost to the Government, gauges, patterns, or other records to enable the Contractor to make repairs and replacement parts.
2. All special gauges and templates necessary for field erection will become the property of

the Government.

3. Patterns are to remain the property of the Contractor.

6.04 RECOMMENDED CAVITATION REPAIR PROCEDURE

A. Provide a procedure for cavitation repair as per RSN 002 with the following information included:

1. Recommended weld rod materials.
2. Preparation and weld procedures.
3. Pre and post weld heat treatment procedures.
4. Template locating drawings.

SECTION 7 - DRAWINGS

7.01 GENERAL

A. Contractor Provided Drawings:

B. Minimum information in the title block:

1. Contract number and "Wide Head Range Turbine Runner for Hoover Dam Unit A2, N7", Contractor's name, drawing number, "A2, N7", part name, and as-built changes with revision dates.
    a. For the counterclockwise unit use "A2", and for the clockwise unit use "N7". Any component that is the same for the two use "A2, N7"
2. Allow a space of 3- by 3-inches for review stamps on each drawing.
3. Drawings shall be ANSI D size (22 inches by 34 inches).
4. Draw to scale using computer drafting.
5. Show as-machined changes made during fabrication, including revision dates.
6. Ensure drawings follow ASME Y14.1 and Y14.5 standards where applicable
7. Submit as both a PDF and an AUTOCAD (.dwg).
    a. AUTOCAD files must be compatible with the latest version available during the bidding period for this contract.

C. Government Provided Drawings:

1. Inform the Government of any discrepancies, errors, or omissions discovered on drawings in accordance with FAR 52.236-21, Specifications and Drawings for Construction.
    a. In the case of a discrepancy, written specifications take precedence over drawings unless otherwise specified.
2. PDFs of all the drawings listed in Table 4 will be furnished by the Government to the Contractor as part of this solicitation.
    a. One additional set of full-size drawings (ANSI size D) will be furnished to the Contractor after contract award.
    b. Additional half-size (11 inches by 17 inches) copies of each drawing shall be furnished to the contractor upon request.

7.02 MANUFACTURING AND DETAIL DRAWINGS

A. Provide drawings for each system:

1. Runner Crown
2. Runner Band

3. Runner Blades
    a. Include blade shaping method.
4. Runner Cone
5. Coupling Bolts and Nuts
    a. For nose cone to runner coupling and runner to turbine shaft coupling.
6. Nameplate

B. Include material information and weight of individual components on each drawing.

C. Include fabrication location for lifting lugs and position holes.

7.03 ASSEMBLY AND INSTALLATION DRAWINGS

A. Provide drawings for each system:

1. Inlet and outlet edge of runner blades
    a. Include drawings of the blade template and template location for reference.
2. Runner assembly and fabrication.
3. Distributor Assembly:
    a. Plan and section view of the scroll case, stay ring, draft tube, servomotor, runner, turbine shaft, operating ring, linkages, headcover, bottom ring, wicket gates, bushings, thrust ring, and gate lever.
    b. Weight of the runner, nose cone, and coupling bolts and nuts.
    c. Moment of inertia (WR_2) of the runner watered and un-watered.
4. Runner Lifting and Handling:
    a. Include drawings with details and instructions for lifting and handling the runner.
    b. Rigging arrangements and lifting points for slings, shackles, etc.

7.04 FINAL DRAWINGS

A. Provide updated versions for all submitted drawings:

1. Include final dimensions of components after machining.
2. Final machined weight of components.
3. Finish of components.
4. Results of runner balance and details of balance modifications.
5. All drawings provided under this solicitation shall become property of the government.

7.05 LIST OF PROVIDED DRAWINGS

A. Drawings listed in Table 4 – List of Provided Drawings, are made a part of these specifications.

B. Table 4 - List of Drawings

Drawing Number	**Title**
Baldwin	
33503	Standard 16 9/16x11" Name Plate for Turbine
33298	115,000 H.P. Turbine Details of Lower Cover (N5, N6, N7)
33323-A	115,000 H.P. Turbine Details of Upper Cover (A1, A2, N5, N6, N7)
33323	115,000 H.P. Turbine Details of Upper Cover (N5, N6, N7)
33328	Details of Cylinder Covers Pistons Forked Ends Etc for Servo Motors (A1, A2, N5, N6, N7)
33329	Piston & Connecting Rods, Indicators, Cushion Valves for Servo-Motors (A1, A2, N5, N6, N7)
33343	Arrangement of Fluid Vanes and Runner Seals
33378	Details of Pit Liner (N5, N6, N7)
34435	Details of Pit Liner (A1, A2)
34438	115,000 H.P. Turbine Details of Lower Cover (A1, A2)
34442	Details of Operating Ring (A1, A2)
34447	Details of Stuffing Box Lantern and Gland
34452	115,000 H.P. Turbine Details of Upper Cover (A1, A2)
34471	General Arrangement Plan of Oil, Water, Air and Gauge Piping connecting to Turbine
34685	Standard 16x11" Name Plate for Turbine
42335	Hydraulic Turbine Sectional Elevation
42336	Spiral Case – Section I
42337	Spiral Case – Section II

42338	Spiral Case – Section III
42339	Spiral Case – Section IV
42340	Spiral Case – Section V
42341	Assembly of Spiral Casing Sections (plan)
42343	Hoover Powerplant – Arrangement of Draft Tube
42345	Intermediate Draft Tube
42346	Upper Draft Tube Liner
42348	Upper draft Tube support
42350	Discharge Ring
42352	Bottom Ring
42360	Head Cover Plan Sheet 1 of 2
42360-A	Head cover Sections Sheet 2 of 2
42361	Stationary Wear Rings
42390	Details of runner (fabricated)
42393	Main shaft
Voest-Alpine	
45M-D-700-2	A1, N5 and N6 Installation of New Runner
45M-D-700-3	Stationary Wearing Rings
45M-D-700-5	A1 Upper Stationary Wearing Ring
45M-D-700-7	A1, N5 and N6 Lower Stationary Wearing Ring
45M-D-700-12	A1, N5 and N6 Throat Ring
45M-D-700-16	Unit A1, A2 - Runner
45M-D-700-17	Units N5 N6 N7 - Runner
Precision	
HOV-A1-101M	Wicket Gate Machine Detail (A1)
HOV-A2-102M	Wicket Gate Machine Detail (A2)
HOV-N7-102M	Wicket Gate Machine Detail (N7)
Andritz Hydro	**Counterclockwise – A1/A2**

050-1100-012	Runner Crown Casting
050-1100-013	Runner Band Casting
050-1100-014	Runner Machining
050-1100-015	Runner Fabrication Sheet 1, 2
2222144511 Sh 1-3	Upper and Lower Seal Machining Sheet 1 - 3
050-1100-060-BOM-Rev00	Air Admission Components
050-1100-061-Rev04	Upper Pipe Air Admission
050-1100-062-Rev02	Lower Pipe Extension Air Admission
Andritz Hydro	**Clockwise – N5/N6/N7**
222144500	Runner Machining (Clockwise) Sheet 1, 2, 3
222144501	Runner Fabrication (Clockwise) Sheet 1, 2, 3, 4
050-1100-017	Runner Seal Machining – N6
050-0000-001	Distributor Section – Unit N8
BOR Drawings	
45-D-16306	Location Map
45-D-5485	Typical Cross-Section 1
45-D-13255	Units A1 A2 - Piping Details - Scroll Case and Turbine Air Vents
45-D-13911	Unit N7 - Piping Details - Scroll Case and Turbine Air Vents
45-301-8829	Servomotor Canyon Side Servo Cylinder Head Gate Open End (A1, A2)
45-301-8830	Servomotor River Side Servo Cylinder Head Gate Open End (A1, A2)
45-301-9023	Servomotor Canyon Side Servo Cylinder Head Gate Open End (N5, N6, N7)
45-301-9024	Servomotor River Side Servo Cylinder Head Gate Open End (N5, N6, N7)
45-301-9244	Units A1 A2 N5 N6 N7 Upper and Lower Seal Ring Rough Machining Layout and Details

45-301-9909	Unit A1, N5, and N6 Turbine Air Vents
45-301-10527	A1 Roughening Air Installation Turbine Shaft Machining
45-301-10528	A1 Roughening Air Installation Headcover Machining and Pipe Installation

SECTION 8 - ON-SITE REQUIREMENTS

8.01 SECURITY

A. In accordance with HSPD-12, all on-site Contractor personnel shall have a Government-issued Personal Identity Verification (PIV) card prior to being allowed access to work at Hoover Dam.

1. The Contractor shall bear the costs of submitting the requisite forms, traveling to a credentialing center, and, if applicable, security interviews.
2. The Government will bear the cost of the background investigation.

B. For each employee who will work at Hoover Dam, complete the following forms:

1. Request for Initiation of Contractor Background Investigation
2. Declaration for Federal Employment
3. Fair Credit Authorization
4. All forms listed within this section shall be provided by the government to the contractor.

C. Promptly mail the completed forms to the COR at the following address:

- Hoover Dam
- PO Box 60400
- Boulder City, NV 89005-0400
- ATTN: [TBD at time of AWARD]

D. Following submission of the requisite forms, the employee will receive an email from the Reclamation Security Office (@usbr.gov) with instructions to complete the online questionnaire (e-QIP) and to make an appointment at a credentialing center to enroll for a PIV card, be fingerprinted, and have a photo taken.

E. Following completion of the requisite forms, e-QIP, and fingerprinting, the Office of Personnel Management (OPM) will initiate the background investigation and a preliminary Special Agreement Check (SAC) will be conducted.

1. If the SAC result is unfavorable, the employee will not be permitted to work at Hoover Dam.
2. If the SAC result is favorable, the employee will be permitted to work at Hoover Dam. However, if the official background investigation result is unfavorable, employment will be terminated.
3. If an employee is terminated, the Contractor shall replace the employee with an employee who possesses equivalent technical qualifications and whose SAC is favorable.

F. The PIV card shall be obtained from the Hoover Dam Security Office and returned upon completion

of on-site work.

8.02 SAFETY

A. Perform all work in accordance with the applicable standards from OSHA, RSHS, and HECP.

B. Prior to commencement of work requiring Lockout/Tagout:

1. The Contractor's site superintendent and foremen shall take and in-person facility HECP class and pass the test (estimated 2 hours).
2. The Contractor's site superintendent shall lock onto the clearance lockbox with a uniquely keyed lock and walk the clearance limits. The lock shall be labeled with the name and primary phone number of the superintendent.

C. Prior to commencement of work requiring Confined Space Entry:

1. Develop and submit a confined space entry program to the COR.
2. Inspect air monitoring equipment for proper function.

D. Prior to commencement of work requiring Fall Protection:

1. Develop and submit a site-specific rescue plan to the COR.
2. Inspect fall protection equipment for proper function.

8.03 PARKING

A. If the worksite is in the Powerhouse, the Contractor may park not more than two company vehicles on the tailrace ramp. All vehicles will be subject to move at a moment's notice. Vehicles shall be marked with the Company's logo or display a sign in the driver's side window which contains the following information:

1. Company's name.
2. Driver's name and phone number.
3. COR's name and phone number.

B. Park all other vehicles at the Hoover Dam Central Warehouse.

8.04 USE OF GOVERNMENT LAND

A. The Contractor will be permitted use of Government land, controlled by the Bureau of Reclamation, for field offices, storage yards, and other construction and service facilities required for the work. Laydown areas will vary depending on location of the worksite. Additional laydown areas are available at the Hoover Dam Central Warehouse. Equipment laydown areas and vehicle parking areas will be designated by the COR. To the extent feasible, the COR will provide dedicated locations for laydown and storage. However, contractor must take appropriate measures to secure and protect contractor- owned/provided materials and equipment, as use of the designated areas may

not be exclusive.

B. No charge will be made to the Contractor for the use of Government land for work activities under this contract.

8.05 PROTECTION OF EXISTING INSTALLATIONS

A. In accordance with Federal Acquisition Regulation (FAR) 52.245-1, the Contractor shall take all precautions to safeguard existing buildings, equipment, and vegetation on the Government installation from damage.

B. If the Contractor's failure to use reasonable care causes damage to any of this property, the Contractor shall replace or repair the damage at no expense to the Government as the Contracting Officer directs; or, at the option of the Contracting Officer, any such damaged may be repaired by the Government, and the Contractor will be back charged for the cost thereof.

1. The time and manner permitted for remediation will be determined by the Contracting Officer.
2. If the Contractor fails or refuses to make such repair or replacement, the Contractor shall be liable for the cost, which may be deducted from the contract price.

8.06 GOVERNMENT-SUPPLIED LABOR AND MATERIALS

A. The Government-supplied items include:

1. Drawings showing existing turbine runner installations.
2. Labor to remove existing turbine runners.
3. Labor to install the new turbine runners supplied by the contractor (including fasteners, nose cone, air admission support cone, and roughing air pipework in the nose cone).
4. Performance tests to determine if the turbine runner(s) meet requirements for efficiency and horsepower.
5. Cableway crane operation to lift/carry items up to 150 tons.

8.07 GOVERNMENT FURNISHED FACILITIES

A. Upon request by the Contractor, utilities and facilities will be made available by the Government at no charge for use in the performance of work under this contract.

B. The Contractor shall:

1. Evaluate the adequacy of the utilities and facilities for its purposes.
2. Furnish all equipment and labor necessary to convey utilities to the worksite.
3. Specify in its proposal all utilities the Contractor intends to request.

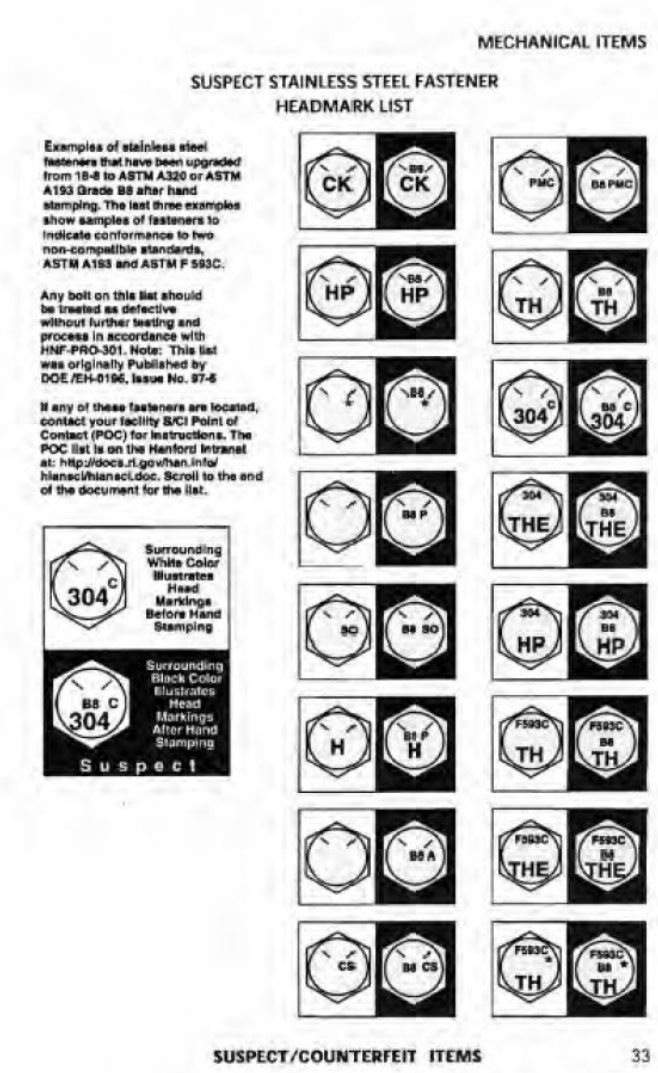
4. Capture the costs of furnishing necessary equipment and labor in its price schedule.
5. Remove all furnished equipment from the worksite upon completion of work.

C. Do not adversely impact the performance or operation of the Government's utility systems.

SECTION 9 - APPENDIX

9.01 APPENDIX A - EXCERPT FROM PAGE 14 OF THE HSS SUSPECT/COUNTERFEIT

ITEMS AWARENESS TRAINING



MECHANICAL ITEMS

SUSPECT STAINLESS STEEL FASTENER
HEADMARK LIST

Examples of stainless steel fasteners that have been upgraded from 18-8 to ASTM A320 or ASTM A193 Grade B8 after hand stamping. The last three examples show samples of fasteners to indicate conformance to two non-compatible standards, ASTM A193 and ASTM F 593C.

Any bolt on this list should be treated as defective without further testing and process in accordance with HNF-PRO-301. Note: This list was originally Published by DOE /EH-0196, Issue No. 97-6

If any of these fasteners are located, contact your facility S/CI Point of Contact (POC) for instructions. The POC list is on the Hanford Intranet at: http://docs.ri.gov/han.info/hiansci/hiansci.doc. Scroll to the end of the document for the list.

304 C — Surrounding White Color Illustrates Head Markings Before Hand Stamping

B8 C 304 — Surrounding Black Color Illustrates Head Markings After Hand Stamping

Suspect

CK | B8 CK
PMC | B8 PMC
HP | B8 HP
TH | B8 TH
B8 *
304 C | B8 C 304
B8 P
304 THE | 304 B8 THE
SO | B8 SO
304 HP | 304 B8 HP
H | B8 P H
F593C TH | F593C B8 TH
B8 A
F593C THE | F593C B8 THE
CS | B8 CS
F593C TH | F593C B8 * TH

SUSPECT/COUNTERFEIT ITEMS 33

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9.02 APPENDIX B – EXCERPTS FROM PAGE 22 AND 23 OF THE HSS

SUSPECT/COUNTERFEIT ITEMS AWARENESS TRAINING

III. FASTENERS

A. General Indications:

- No manufacturer's or grade mark (unless certified to a specification not requiring marking)
- Evidence of machining marks
- Poor thread form, evidence of wear, or dressing
- Headmarks shown on the Suspect Fastener Headmark List
- Foreign manufacturer not meeting Public Law 101-592
- No markings for nuts or washers packaged with labels indicating that they were manufactured to a code or MIL-SPEC which requires marking
- Headmarkings are marred, missing, or appear to have been altered
- Headmarkings are inconsistent with a hear/lot
- Double stamping
- Metric and SAE stamping
- Headmarks with raised marks and depressed marks on same bolt (not normal manufacturing process)

IV. DOCUMENTATION AND CERTIFICATION:

A. General Indications:

- Use of correction fluid or correction tape
- Type style or pitch change is evident
- Documentation has missing (or illegible) signature, initial, or data
- Document is excessively faced or unclear
- Inconsistent technical data
- Certification or test results are identical between items when normal variations should be expected
- Document is not traceable to the items procured
- Technical data are inconsistent with code or standard requirements
- Documentation is not delivered as required on the purchase order, or in an unusual format
- Lines on forms are bent, broken, or interrupted indicating that data have been deleted or exchanged by "cut and paste"

- Handwritten entries are on the same document where typed or pre-printed data exist
- Data on a single line are located at different heights
- Product recall
- Chemical alloy composition totals 100% (or >99.75%) as shown on Certified Material Test Report (CMTR)
- Heat and lot numbers are same for different materials in same order (i.e. 6010 and 7018 weld wire cannot be manufactured from same heat and lot of material.)

END OF STATEMENT OF WORK