TVA

Tennessee Valley Authority, Post Office Box 2000, Decatur, Alabama 35609-2000

October 17, 2006

10 CFR 50.55a

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Mail Stop: OWFN P1-35
Washington, D.C. 20555-0001

Gentlemen:

In the Matter of	)	Docket No. 50-296
Tennessee Valley Authority	)	

BROWNS FERRY NUCLEAR PLANT (BFN) - UNIT 3 - AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME) SECTION XI, INSERVICE INSPECTION PROGRAM FOR THE THIRD TEN-YEAR INSPECTION INTERVAL - REQUEST FOR RELIEF 3-ISI-2, RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI) (TAC NO. MC8786)

TVA submitted, by letter dated October 19, 2005, its Third Ten-Year Inservice Inspection (ISI) and System Pressure Test (SPT) Programs for Unit 3 of the Browns Ferry Nuclear Plant. The Code of record for the Third Ten-Year Interval ISI and SPT Programs is the 2001 Edition, 2003 Addenda of the ASME Boiler and Pressure Vessel Code, Section XI. The Third Ten-Year Interval began on November 19, 2005.

During its review of the BFN Unit 3 Third ten-year Interval Inservice Inspection Program, the NRC staff identified questions, by letter dated July 31, 2006, regarding BFN Unit 3 request for relief 3-ISI-2. Request for relief 3-ISI-2 addresses TVA's proposed alternative for examination and testing of snubbers. As a result, TVA is providing responses to the NRC questions in Enclosure 1 of this letter. Enclosure 2 of this letter contains the revised request for relief 3-ISI-2 that incorporates the TVA responses to the NRC questions.

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There are no new commitments contained in this letter. If you have any questions, please contact me at (256) 729-2636.

Sincerely,

William D. Crouch

William D. Crouch
Manager of Licensing
and Industry Affairs

Enclosures
cc: See Page 3

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ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM,
THIRD TEN-YEAR INSPECTION INTERVAL

REQUEST FOR RELIEF 3-ISI-2, EXAMINATION AND TESTING OF SNUBBERS,
RESPONSE TO NRC INFORMAL REQUEST FOR
ADDITIONAL INFORMATION (RAI)

(SEE ATTACHED)

ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM,
THIRD TEN-YEAR INSPECTION INTERVAL

REQUEST FOR RELIEF 3-ISI-2, EXAMINATION AND TESTING OF SNUBBERS, RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION (RAI)

During its review of the BFN Unit 3 Third Interval Program, the NRC staff identified questions regarding request for relief 3-ISI-2. These questions were transmitted to TVA by NRC letter dated July 31, 2006. Listed below are the specific NRC questions and the corresponding TVA responses.

Request for relief 3-ISI-2 has been revised (see Enclosure 2) to reflect the following responses as applicable and is consistent with the BFN Unit 1 request for relief 1-ISI-18 approved by NRC letter dated April 30, 2004. In accordance with 10 CFR 50.55a(a)(3)(i), TVA believes that the proposed request for relief, 3-ISI-2, provides an acceptable level of quality and safety.

To support NRC's review of TVA responses below, TVA is providing the following procedures as attachments to this enclosure that are referenced in the responses.

Attachment A - BFN Unit 3 Technical Requirements Manual, Section 3.7.4, Snubbers (with Bases)

Attachment B - BFN Surveillance Instruction (SI) 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

Attachment C - BFN SI 0-SI-4.6.H-2A, Functional Testing of Mechanical Snubbers

Attachment D - BFN SI 0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor/Darling, or Fronek Hydraulic Snubbers

Attachment E - BFN SI 0-SI-4.6.H-2C, Functional Testing of Bergen-Paterson Torus Dynamic Snubbers

Attachment F - BFN SI 0-SI-4.6.H-2E, Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers

Attachment G - BFN Technical Instruction (TI) 0-TI-398, Snubber Program Procedure

Attachment H - BFN Mechanical Preventive Instruction (MPI) MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, and Fronek Unit Disassembly and Reassembly

Attachment I - BFN Mechanical Preventive Instruction (MPI) MPI-0-000-SNB004, Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, and Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers

NRC Request 1

The licensee requested relief from the requirements of IWF-5300(a) and (b) and IWF-5400 of Article IWF-5000. The article IWF-5000 also contains requirements for snubber preservice examinations and tests in IWF-5200 and requirements for integral and nonintegral attachments for snubbers in IWF-5300(c). Explain whether and how the requirements of IWF-5200 and IWF-5300(c) will be met.

TVA Response to NRC Request 1

Subarticle IWF-5200 is referenced in IWF-5400. Subarticle IWF-5400 is listed in TVA's request for relief 3-ISI-2 as a Code requirement for which relief is requested. TVA's intent was that IWF-5200 was not applicable for repairs and replacements. IWF-5200(a) and (b) will be performed by the TRM Snubber Program. As stated in TVA's request for relief, the structural portions of the component supports, other than the snubbers, inclusive of the pins back to the building structure and also the component/piping being supported, will remain in the ASME Section XI examination boundary (ISI Program); therefore, IWF-5200(c) and IWF-5300(c) are met by the Section XI Program.

NRC Request 2

On page 140, the licensee requested relief in item (a) from Section IWF-5400 and American Society of Mechanical Engineers (ASME)/American National Standards Institute (ANSI) OM-1987, Part 4 with OMa-1988, Section 1.5.6 and 1.5.7. IWF-5400 States:

Snubbers installed, corrected or modified by repair/replacement activities shall be examined and tested in accordance with the applicable requirements of IWF-5200 prior to return to service.

Explain whether and how IWF-5200 requirements will be met.

TVA Response to NRC Request 2

See TVA's response to NRC request 1 above.

NRC Request 3

On page 140, Basis for Relief, the licensee stated that the Plant Technical Requirement Manual (TRM) Section TR 3.7.4 is prepared in accordance with the guidance given by NRC in Generic Letter (GL) 90-09. GL 90-09, only provides guidance for Snubber Visual Examination Intervals and Corrective Actions. GL-90-09 does not replace any other requirements of the Operating Manual (OM) Part 4, such as preservice examination (Section 2.1), examination documentation (Section 2.4), inservice operability testing (Section 3.2), testing documentation (Section 3.3), etc. Explain how these requirements are met in the proposed alternative.

TVA Response to NRC Request 3

Below TVA is providing a comparison of the OM Part 4 requirements in Sections 2.1, 2.4, 3.2, and 3.3 and the BFN TRM alternatives.

OM Part 4 Section 2.1.1a) There are no visible signs of damage or impaired operability as a result of storage, handling or installation...

The alternate requirements in the BFN Surveillance Instruction (SI) 3-SI-4.6.H-1, Attachment 2A checklist reads: "The snubber has no visible indications of damage or impaired operability."

OM Part 4 Section 2.1.1b) the snubber load rating, location, orientation, position setting, and configuration (attachments, extensions, etc.) are in accordance with design drawings and specifications. Installation records (based on physical inspections) verifying the snubbers were installed according to design drawings and specifications shall be acceptable in meeting this requirement.

The BFN alternate requirements in SI 3-SI-4.6.H-1 are as follows: Section 7.2.7 states "the snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location." Section 7.2.8 states "the snubbers are listed in Appendix A by exam number." Appendix A provides additional information such as snubber drawing no., type/size, support number, and location. Snubber drawing no. may be used to access the design drawing of a snubber, showing the location plan, material description, orientation, configuration (to include attachments, extensions and others), design requirements such as design travel/thermal movements and position settings. Section 7.2.9 of the SI states that "a unique snubber/support number is given to each snubber location on a system."

MPI-0-000-SNB004, Attachment 1, Note 3 states: "Document removal and reinstallation data for the snubber on Attachment 4." Snubber data listed in Attachment 4 relevant to these requirements includes: As-Found Position Indication Reading (for mechanical type), As-Found Index (Plunger) Reading, As-Found Piston Reading and others (for hydraulic type). Collection and recording data in Attachment 4 is done prior to removal of the snubber for functional testing and after reinstallation.

OM Part 4 Section 2.1.1c) adequate swing clearance is provided to allow snubber movement

The BFN alternate requirement states that the item is to be observed in performance of visual SI 3-SI-4.6.H-1. Attachment 2A of the SI states: Centerline of the clamp assembly and structural attachment offset (i.e., a misalignment with the snubber axis exists) by no greater than plus or minus 6 degrees based on the clearances between the rod eyes, paddles, and the attachment clevis. Contact of these parts, which produces a side load on the snubber is unacceptable. Observe spacers are installed on each side of the snubber eye to reduce the misalignment and or binding. Space shall not exceed 1/16 inch on either side or 1/8 inch total. Observe for evidence of torsional binding (i.e. mechanical snubber twisted along its axis by the pipe clamp and structural attachments).

OM Part 4 Section 2.1.1d) if applicable, fluid is at the recommended level and fluid is not leaking from the snubber system.

The BFN Alternate fluid level acceptability check for hydraulic snubbers in the visual SI 3-SI-4.6.H-1 data sheets or Attachment 2B, 2C and 6 states:
If the fluid level is unacceptable, but not empty, add GE SF 1154 silicon fluid using a fluid gun with a special hydraulic fill coupling until the fluid level reading is at or approximately same as the piston rod extension given above. Examine snubber for location and cause of leaks. Record locations in Remarks Section on Attachment 1. MPI-0-000-SNB004, Attachment 1, Section 1.1 states: "perform visual inspection of the snubber for any visible damage or fluid leakage." Further, Section 1.3.6 states: "if the fluid level is unacceptable, but not empty, add GE SF 1154 silicon fluid using a hydraulic fluid gun until the fluid level reading is at or approximately the same as the piston rod extension given above. Notify the Snubber Engineer/Designee to take appropriate action."

OM Part 4 Section 2.1.1e) structural connections such as pins, bearings, studs, fasteners, and other connecting hardware such as locknuts, tabs, wire and cotter pins are installed correctly.

The BFN Unit 3 alternate checklist items in SI 3-SI-4.6.H-1, Attachment 2A, Section 2, states: "Attachments to the foundation or supporting structure are functional." "Observe the exposed hanger structural steel, pipe clamps, base plates, lugs and other such plates of attachment for broken parts, deformation or other damage."

Attachment 2A, Section 3. states: "Fasteners for the attachment of snubber to the component and to the snubber anchorage are functional."

- Observe to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed.
- Observe to ensure clevis bolts or pins are properly installed.
- Observe for the following attributes which may cause future problems but do not affect snubber operability or any acceptance criteria; pits, scratches, or rough places observed on the piston rod, cotter pins properly installed with legs bent sufficiently to prevent cotter pin from backing out, pivot pin retaining ring is properly installed and security locking devices (i.e., locking tabs or wire) on snubber attachment bolts properly installed, if required.

OM Part 4 Section 2.4 a) checklists verifying preservice and inservice examination, fluids levels, and as-found conditions. Appendix A of this Part represents items normally included in a checklist (as follows):

- **rotated reservoirs (hydraulic fluid could not reach valve blocks)**

  BFN Unit 3 does not have rotated reservoirs as snubber checklist item.

- **Piston shaft painted, which could cause a frozen condition**

  The BFN Unit 3 alternate requirements are provided in SI 3-SI-4.6.H-1, Attachment 2A, Section 1 states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance. Observe the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability of the snubber."

- **Units installed upside down**

  The BFN Unit 3 Alternate requirements are provided in SI 3-SI-4.6.H-1, Section 6.1.1(4) which states: "The snubber has the proper orientation, and adequate fluid level, if applicable."

- **Sight glass broken**

  The BFN Unit 3 Alternate requirements are provided in SI 3-SI-4.6.H-1, Attachment 2A, Section 1 which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Installed with preset shipment screws for shipping (screws must be removed before service)**

  The BFN Unit 3 functional testing of snubbers demonstrates free/unrestricted snubber movement in tension and compression directions. For a snubber to move freely, the preset shipment screws for shipping must be removed before the test. MPI-0-000-SNB004, Section 2.11 states that: "For Lisega Torus Dynamic Restraints, VERIFY the 2-way valve positioner is in the vertical position. Record on Attachment 4." There is no preset shipment screw for shipping to remove on a Lisega Torus Dynamic Restraints.

- **Hydraulic fluid lines for snubber remote reservoir placed too close to hot pipe causing the lines to burst**

  The BFN Unit 3 Alternate requirements are provided in MAI-4.2A Piping/Tubing Support Installation Data Sheet which documents clearances per MAI-4.10 applicable to SR, QR, or NQR supports in Category 1 Structures.

  MPI-0-000-SNB004, Attachment 1, section 2.1, Note (2) states that: "Any required relocation of the strut attachment to clear an interference should be brought to the attention of Site Engineering (Civil)."

- **Snubber placed in wrong location**

  The BFN Unit 3 alternate requirements are provided in SI 3-SI-4.6.H-1, Section 7.2.7: "The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location." Section 7.2.8; "The snubbers are listed in Appendix A by exam number." Note: Appendix A also provides a specific location of a snubber with a unique identification number (UNID).

- **Clevis pins not attached to anchor**

  The BFN Unit 3 alternate requirements are provided in SI 3-SI-4.6.H-1, Attachment 2A, Section 3 which states: "Fasteners for the attachment of the snubber to the component and to the snubber anchorage are functional. Observe to ensure clevis bolts or pins are properly installed. Observe to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed."

- **Snubber not installed at correct location**

  The BFN Unit 3 Alternate requirements are provided in 3-SI-4.6.H-1, Section 7.2.7 which states: "The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber or support location. Section 7.2.8 states: "The snubbers are listed in Appendix A by exam number." Note: 3-SI-4.6.H-1, Appendix A also provides a specific location of a snubber with a unique identification number (UNID).

- **Bent or scored piston rod**

  The BFN Unit 3 Alternate requirements are provided in 3-SI-4.6.H-1, Attachment 2A, Section 1 which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Welding arc strikes**

  The BFN Unit 3 alternate requirements are provided in 3-SI-4.6.H-1, Attachment 2A, Section 1 which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance."

- **Lubrication of pivot points**

  The BFN Unit 3 alternate requirements are provided in MPI-0-000-SNB004, Attachment 2, Section 2.3 which states: "Apply anti-seize thread lubricant to the surface of the pivot pins and to all threaded fasteners that are being installed."

- **Abnormal spherical bearing position**

  The BFN Unit 3 Alternate requirements are provided in MPI-0-000-SNB004 Section 7.2.2 which states: "If a spherical bearing is found to be dislodged from the paddle housing, REINSERT by carefully pressing or tapping on the outer race. Use a Bergen-Paterson bearing installation tool or an appropriate sized pipe to assure proper alignment." MPI-0-000-SNB004, Section 7.2.3 states: After the spherical bearing has been reinserted into the paddle if required, USE a center punch and MOVE approximately 1/32 inch away from the exterior of the spherical bearing race and with as little force as possible MAKE four punch indentations equally spaced around the race at approximately 90 degrees, on both sides of the paddle.

- **Protective coverings or plugs removed (after shipping or maintenance)**

  Snubbers received from the warehouse are free of protective coverings or plugs removed and ready for examination and testing as required.

- **Fluid level indicators and/or position indicators accessible for visual inspection**

  The BFN Unit 3 Alternate requirements are provided in MPI-0-000-SNB004, Attachment 1 Section 2.3 which states: "At the end of each installation, CHECK each unit as a precaution for the following information."

  - Snubber Serial Number.
  - Piston rod extension dimension.
  - Fluid level indicator reading.
  - Whether or not fluid was added to bring unit to proper level.

- Visible condition of the unit.
- Condition of the strut assembly with particular attention to the clamp and the bolting tightness.
- Cotter pins installed in clevis pins.

- **No visible corrosion or mechanical defects of working parts or surfaces**

  The BFN Unit 3 alternate requirements are provided in 3-SI-4.6.H-1, Attachment 2A, Section 1 which states: "The snubber has no visible indications of damage or impaired operability. Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance. Observe the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability."

OM Part 4 Section 2.4 b) examination records

All examination records are documented in Attachments 2A, 2B, 2C, and 6 of the 3-SI-4.6.H-1 and in Attachment 4 of MPI-0-000-SNB004. Visual examination records performed to facilitate testing are also documented in the appropriate attachments of applicable SIs 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C and 0-SI-4.6.H-2E.

OM Part 4 Section 2.4 c) thermal movement inspection records

The stroke setting (As-Found/As-Left) which relates to thermal movement (shown in design drawings) for a given snubber are documented in Attachment 4 of MPI-0-000-SNB004, and Attachments 2A, 2B, 2C, and 6 of 3-SI-4.6.H-1 and in the appropriate attachments of the applicable SIs 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C and 0-SI-4.6.H-2E.

OM Part 4 Section 2.4 d) nonconformance and corrective action required to be completed during the preservice and inspection interval

The BFN Unit 3 alternate requirements are provided in 3-SI-4.6.H-1, Section 7.2.6 which states: Evaluation sheets (Attachments 3, 4, and 5) shall be prepared and submitted with the data package, as appropriate, by the Snubber Engineer/SE Designee for each degraded or inoperable snubber identified by the performance of this instruction.

Section 7.3.1.1 states: "If any snubber is determined to be inoperable, Site Engineering Civil should initiate a Problem Evaluation Report (PER). MMG Planning should write a minor maintenance Work Order (WO) to perform the necessary repairs required to return the inoperable snubber to operable status." The checklist in Attachment 2A, Sections 1, 2, and 3 states: Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1, Conduct of Testing, and SPP-3.1, Corrective Action Program.

OM Part 4 Section 3.2.1.1 a) the force that will initiate motion (breakaway force), the force that will maintain low velocity displacement (drag force), or both, as required by the documents of Paragraph 1.5.2 (Procedures and Instructions), is within specified limits, both in tension and compression

Drag tests performed on snubbers are in accordance with 0-SI-4.6.H-2A, -2B, -2C and -2E, generally using the STB 200 Test Bench. Drag test result/computer printout is a graph of Velocity (ipm), Position (inches) and Force (lbs).

0-SI-4.6.H-2A, Section 6.2.3 states: The drag force (force required to initiate or maintain motion) of the snubber, is not great enough to over stress the supported component or system during thermal movement, or to indicate impending failure of the snubber.

0-SI-4.6.H-2A, Section 6.2.4 states: The drag force shall not exceed the maximum of 5% of the snubber rated load, Table 6.6-2, or Attachment 6, if applicable. As-Found drag forces greater than 4% but less than 5% of the snubber rated load shall be evaluated for impending failure.

0-SI-4.6.H-2A, Section 6.2.5 states: As-Found drag forces greater than the maximum acceptable drag force from Table 6.2-1, Table 6.2-2, or Attachment 6 shall require a supported component or system analysis by Site Engineering Civil, Attachment 4.

0-SI-4.6.H-2B, Section 6.2.1 states: The snubber functional test shall verify that the As-Found drag force does not exceed 2% of the snubber's rated load. Test data/computer print out are documented in Attachment 2.

0-SI-4.6.H-2B, Section 6.2.2 states: The snubber functional test shall verify that the As-Left drag force does not exceed 2% of the snubber's rated load. Test data/computer print out are documented in Attachment 2.

0-SI-4.6.H-2C, Section 6.2.3 (As-Found) and 6.3.3 (As-Left) state: Drag force shall be less than or equal 15,000 pounds. Test data/computer print out are documented in Attachment 2.

0-SI-4.6.H-2E, Section 6.2.3 (As-Found) and 6.3.3 (As-Left) state: Drag force shall be less than or equal to 15,000 pounds. Test data/computer print out are documented in Attachment 2.

Breakaway force is a test parameter printed in the test data for drag test performed, normally less than the maximum drag force.

OM Part 4 Section 3.2.1.1 b) activation is within the specified range of velocity or acceleration in both tension and compression

Acceleration tests performed on mechanical snubbers are in accordance with 0-SI-4.6.H-2A. LOCKUP and BLEED TEST performed on hydraulic type snubbers are in accordance with 0-SI-4.6.H-2B, -2C, and -2E. These tests are generally done on the STB 200 Test Bench. Acceleration Test, Lockup and Bleed Test data/computer printouts are graphs of Velocity (ipm), Time (seconds) and Force (lbs).

0-SI-4.6.H-2A, Section 6.2.1 for mechanical snubbers states: The snubber functional test shall verify that Activation (restraining action) occurs, in both tension and compression.

Section 7.4 Notes: (1) Activation verification may be performed manually or with power assist devices and gauges, provided to indicate changes in the snubber resistance. (2) Orientation of the snubber is of no consequence during the activation test.

0-SI-4.6.H-2B, Section 6.2.1 states: The snubber functional test shall verify that the "As-Found" Corrected Activation occurs in both directions of travel at a piston velocity greater than or equal to 1 inch/minute and less than or equal to 30 inches/minute.

SI 0-SI-4.6.H-2B, Section 6.2.2 states: The snubber functional test shall verify that the "As-Left" Corrected Activation occurs in both directions of travel at a piston velocity greater than or equal to 5 inches/minute and less than or equal to 20 inches/minute. Test data/computer print out are recorded in Attachment 2.

SI 0-SI-4.6.H-2C, Section 6.2.1 (As-Found) and 6.3.1 (As-Left) state: Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute. Test data/computer print out are recorded in Attachment 2.

SI 0-SI-4.6.H-2E Section 6.2.1 (As-Found) and 6.3.1 (As-Left) state: Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute. Test data/computer print out are converted and documented in Attachment 2.

OM Part 4, Section 3.2.1.1 c) - release rate, where applicable, is within the specified range in tension and compression. For units specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be demonstrated.

SI 0-SI-4.6.H-2B, Section 6.2.1 (As-Found) states: The snubber functional test shall verify that: Corrected bleed shall take place after activation of the snubber in both the tension and compression direction.

SI 0-SI-4.6.H-2B, Section 6.2.2 (As-Left) states: The snubber functional test shall verify that: Corrected bleed shall take place after activation of the snubber in both tension and compression and shall be within the ranges shown in Appendix C for each size of snubber. Test data BLEED (RELEASE) Rate are recorded in Attachment 2.

SI 0-SI-4.6.H-2C, Section 6.2.2 (As-Found) states: Bleed shall take place after activation of the snubber, in both the tension and compression. Test data BLEED (RELEASE) Rate are recorded in Attachment 2.
SI 0-SI-4.6.H-2C, Section 6.3.2 (As-Left) states: Bleed shall take place after activation of the snubber, in both the tension and compression and be greater than or equal 1 inch/minute and less than or equal 10 inches/minute. Test data BLEED (RELEASE) Rate are recorded in Attachment 2.

Snubber specifically required not to displace under continuous load are addressed in TSR 3.7.4.2.

OM Part 4, Section 3.2.1.2, - Operability Test Loads - Snubbers shall be tested at a load sufficient to verify the operating parameters specified in paragraph 3.2.1.1. Testing at less than rated load must be correlated to operability parameters at rated load.

Test Load parameters are built into the Snubber Test Bench Machine Program, and are listed in the applicable Appendixes of 0-TI-398 as follows:

0-TI-398 Appendix B, Section 2.1 states that for Bergen-Paterson, Anchor Darling or Fronek Hydraulic snubbers, Test Loads are in the Snubber Test Machine Program. These Test Loads are 80 percent of rated load for snubber sizes HSSA -3, -10, -20,- 30, ADH/FRONEK -20, -30, -50, -70, and -130.

0-TI-398 Appendix D, Section 1.0, Bergen-Paterson Torus Dynamic Restraints (TDRs) operability test loads is 100 percent of the maximum rated of 200 kip in tension and 230 kips in compression.

Lisega Torus Dynamic Restraints are functionally tested using the Lisega Surrogate snubber in accordance with 0-SI-4.6.H-2E. The test load in the Snubber Test Machine Program is 44.9 kips.
Test data/results are converted and recorded in Attachment 2 of the SI.

0-TI-398 Appendix F, Section 3.0, Pacific Scientific Company (PSA) Mechanical Snubbers, Test Load parameters in the Snubber Test Machine Program are 60 percent of rated load for PSA sizes 1/4, 1/2, 3, and 10 and 50 percent of rated load for PSA sizes 1, 35, and 100.

OM Part 4, Section 3.2.1.3, Qualitative Testing. Qualitative testing may be used in lieu of quantitative measurements in meeting the requirements of paragraph 3.2.1.1, provided adequate justification can be presented and is acceptable to the regulatory authority having jurisdiction over the facility. In those cases, the Owner shall obtain sufficient data, based upon service history or life cycle testing, to justify the ability of the parameter in question to be within specifications over the life of the snubber (e.g., demonstrate that activation takes place without measurement of the activation level). A test report shall be available for each snubber exempted from an inservice quantitative test requirement. The test report must verify that the parameter was within specifications to allow exemption of the snubber from quantitative testing of the parameter.

0-TI-398, Section 7.17 B, Functional Testing of PSA Mechanical Snubbers and BFN Technical Requirements require drag force measurements and activation verifications. Mechanical snubber functional testing is performed to verify two characteristics, activation and drag force. If a mechanical snubber is tested in the field, the test is performed using 2 Push-Pull force gauges. The snubbers are tested 3 times in each direction and the results of the 3 tests are averaged. This is performed in both the extension (tension) and retraction (Compression) directions. This is considered to be a qualitative testing method. The qualitative test (verification that activation takes place, without a specific value on the activation level) is based on the expectation that the activation level will not drift out of its acceptance range through the life of the snubber.

Performing a quantitative test of activation of PSA snubbers requires a specialized test machine. BFN has a computer controlled API/Barker STB-200 snubber test bench. The test bench is capable of testing any size PSA snubber and most medium and small bore hydraulic snubbers. The software performs four basic functions:

- Operator interface
- Machine control
- Data acquisition and conversion
- Data analysis and presentation

Test results are presented in the form of a graph with maximum and average test values.

OM Part 4, Section 3.2.2, Inservice Operability testing Frequency. Testing shall take place at least every refueling outage using a sample of snubbers in the facility.

TSR 3.7.4.2, Testing Frequency is 24 months.

SIs 0-SI-4.6.H-2A, -2B, -2C and -2E, Section 1.3 - Frequency/Conditions

> This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.
>
> Testing of the 10% sample lot of hydraulic and mechanical snubbers takes place every 24 months/ at each scheduled unit refueling outage in accordance with the TSR 3.7.4.2 and the applicable SI.

OM Part 4, Section 3.2.3, Inservice Operability testing Sample Plans:

The inservice testing sample shall be selected using one of the three sample plans (a comparison of sampling plans is contained in Appendix C):

(a) 10% testing plan
(b) 37 testing plan
(c) 55 testing plan

The snubbers of parallel and multiple installations shall be identified and counted individually. All fractional sample sizes shall be rounded up to the next integer.

0-TI-398, Section 7.17, 2nd paragraph of the Functional Test Program Guidelines states: Functional tests are performed each operating cycle to meet Technical Surveillance Requirements TSR 3.7.4.2 verifying, by sampling 10% of each subcategory of snubber, that the safety-related snubbers are operable. For each failure to meet the functional test acceptance criteria an additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. Fractional sample sizes are not rounded up to the next integer. Specific requirements are given in the appropriate functional testing SI. The appropriate SIs for functional testing of snubbers are: 0-SI-4.6.H-2A, -2B, -2C and -2E.

3-SI-4.6.H-1, Appendix A is a snubber listing of each individual snubber shown on a pipe support drawing. Each snubber is given a unique identification number and is counted individually as listed in Appendix A.

OM Part 4, Section 3.2.4, Inservice Operability Testing Failure Evaluations

TSR 3.7.4.3 states that: A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of failure. The frequency is once for each discovery of snubber failure to meet functional acceptance criteria.

0-SI-4.6.H-2A, -2B, -2C, and -2E, Attachment 3 provides the requirements for performing failure evaluations of failed snubbers.

OM Part 4, Section 3.2.4.1, Failure Evaluation Requirements. Snubbers that do not meet the operability testing acceptance criteria in paragraph 3.2.1 shall be evaluated to determine the cause of the failure.

The BFN Unit 3 TSR 3.7.4.3 mandates that failure analysis be made for each snubber failure to meet the functional test acceptance criteria in TSR 3.7.4.2 or the applicable SIs:

0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C and 0-SI-4.6.H-2E state: An Engineering Failure Analysis for Inoperable Snubber must be performed or completed using the appropriate data sheets or attachments of the applicable SIs to determine the cause of failure. Results of this analysis shall be used to select snubbers to be tested in an effort to determine the operability of other snubbers with the same failure mode. Selection of snubbers for future testing may also be based on the failure analysis. This evaluation may also be used by Site Engineering when required to perform a supported system/component analysis.

For each failed snubber, a PER is initiated in accordance with SPP-8.1 and SPP-3.1, a Work Order is initiated to replace the snubber (if necessary), perform in place or STB 200 Test Bench functional test on an additional lot equal to 10% of the remaining snubbers of that type. Testing shall continue until no additional inoperable snubbers are found within the subsequent lots or all snubbers of the original test type are tested or all suspect snubbers identified in the failure analysis have been tested, as applicable in accordance with the TSR 3.7.4.2 or the applicable SIs listed above.

0-SI-4.6.H-2A, -2B, -2C and -2E state: For inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does not meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM. The engineering evaluation is to determine if component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

OM Part 4, Section 3.2.4.2, Test Failure Mode Groups - Unacceptable snubber(s) shall be categorized into test failure mode group(s). A test failure mode group(s) shall include all unacceptable snubbers that have a given failure mode, and all other snubbers subject to the same failure mode. The following failure modes shall be used:

(a) Design/manufacturing
(b) Application induced
(c) Maintenance/repair/installation
(d) Isolated
(e) Unexplained

For BFN Unit 3, TSR 3.7.4.4, NOTE states: This testing is independent of the requirements of TSR 3.7.4.3. For any snubber which fails to lockup or fails to move (i.e., frozen in place), evaluate the cause. If caused by manufacturer or design deficiency, perform in-place or bench functional test of all snubbers of the same design, subject to the same defect. The functional test acceptance criteria shall be as specified in TSR 3.7.4.2.

In addition, the applicable Surveillance Instructions require an engineering evaluation of the snubber failure, and classification of the snubber failure mode as isolated, location, manufacturing, design, or other. The engineering evaluation includes determination of subsequent testing required, based on the failure mode, which may involve testing of snubbers susceptible to the same failure mode. However, establishment of specific groupings based on failure modes is not performed.

OM Part 4, Section 3.2.4.3, Test failure Mode Group Boundaries - Once a test failure mode group has been established, any snubber(s) in that test failure mode group will not be part of the testing groups from which the snubbers originated except as noted in paragraph 3.2.4.4 below. The new test failure mode group will remain as defined until corrective action has been completed.

As stated in response to Section 3.2.4.2 above, establishment of test failure mode groups is not performed.

OM Part 4, Section 3.2.4.4, Snubbers in More Than One Test Failure Mode Group - In the event that a snubber(s) becomes included in more than one test failure mode group, it shall be counted in each failure mode group in which it is unacceptable and shall be subject to the corrective action of each test failure mode group.

As stated in response to Section 3.2.4.2 above, establishment of test failure mode groups is not performed. The corrective action for a snubber subject to multiple failure modes is as determined and documented in the engineering evaluation in accordance with the applicable Surveillance Instruction.

OM Part 4, Section 3.2.5, Inservice operability Testing Corrective Action and Impact on Continued Testing - Snubbers which have been found unacceptable for the testing acceptance criteria of para.3.2.1.1 shall be subjected to the following corrective actions(s) with its indicated impact on continued testing. Selection of the corrective action shall be governed by the sampling plan which is used.

See TVA's response to OM Part 4 item 3.2.4.1 above. For each unacceptable or failed snubber, a PER is initiated in accordance with SPP-8.1 and SPP-3.1, failure analysis performed, Work Order initiated to replace the snubber (if necessary), in place or STB 200 Test Bench functional test performed on an additional lot equal to 10% of the remaining snubbers of that type. Testing shall continue until no additional inoperable snubbers are found within the subsequent lots or all snubbers of the original test type are tested or all suspect snubbers identified in the failure analysis have been tested, as applicable. The functional test criteria shall be as specified in TSR 3.7.4.2 or the applicable test SIs.

OM Part 4, Section 3.2.6, Inservice Operability Testing Methods. The following test requirements shall apply:

(a) testing to be performed on the snubbers in their as-found condition to the fullest extent practical regarding the features to be tested

(b) test methods employed must not alter the condition of the snubber to the extent the results are not representative of the parameters prior to test

(c) inservice operability testing may be accomplished with the snubber installed in its permanent location by utilizing Owner approved test methods and equipment

(d) the snubbers may be removed and bench tested in accordance Owner approved test procedures. After reinstallation, the snubber shall meet the requirements of paragraph 2.1.1(e)

(e) where the physical size of the snubber, test equipment limitations, or inaccessibility of location prevent the use of methods in paragraphs (c) and (d) above, the snubber subcomponents shall be examined and tested in accordance with approved procedures. Reassembly of individual components must be in accordance with approved procedures.

(f) Testing methods may be used which measure parameters indirectly or parameters other than those specified if those results can be correlated to the specified parameters through established methods.

For BFN Unit 3, Operability testing methods for mechanical and hydraulic snubbers are either qualitative (use of 2 Push-Pull force gauges) or quantitative (use of STB 200 Test Bench w/Windows program), in accordance with applicable SIs 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E and TSR 3.7.4.2 requirements and, MPI-0-000-SNB004 for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers and, MPI-0-000-SNB002 for Hydraulic shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly to meet the requirements (a) through (f) above.

OM Part 4, Section 3.3, Testing Documentation Documents necessary to verify result of the preservice and inservice program shall include as a minimum:

(a) preservice operability test procedures and results

(b) inservice operability test procedures and results noncomformance results, noncomformance evaluations, and corrective action.

For BFN Unit 3, 0-SI-4.6.H-2A, 2B, -2C, and -2E provide a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction. Snubber(s) operability tests results, including nonconformance results, nonconformance evaluations, and corrective actions are documented in the appropriate data sheets or attachments of the applicable SIs listed above. These documents are included in the work package for the tested snubber and transmitted to permanent record storage (EDMS) after closure of the work package/Work Order for entry into the database.

NRC Request 4a

On page 140, Alternative Examination, the licensee stated that TR 3.7.4 requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities. The licensee never requested relief from IWF-5200 (see questions 1 and 2). Explain this discrepancy in the relief request.

TVA Response to NRC Request 4a

See TVA's response to NRC request 1 above.

NRC Request 4b

On page 140, Alternative Examination, the licensee referenced several procedures. The details of these procedures are not provided in the relief request. Explain and provide details whether and how these procedures are equivalent to or meet the requirements of Sections 2.4, 3.2, and 3.3 of OM-4.

TVA Response to NRC Request 4b

See TVA's response to NRC request 3 above.

NRC Request 5

On page 141, in the second paragraph, the licensee stated that visual examination of repaired and replaced snubbers will be performed in accordance with MPI-0-000-SNB004. Explain in detail how this examination is equivalent to the requirements of Sections 1.5.6, and 1.5.7 of OM Part 4.

TVA Response to NRC Request 5

OM Part 4, Section 1.5.6, Snubber Maintenance or Repair - Maintenance or repair activities which can alter the snubber's intended function shall be evaluated by considering the effects of maintenance or repair on the snubber's ability to meet the snubber examination criteria. Maintenance or repair activities that affect the ability of the snubber to satisfy its intended function shall be completed in accordance with written procedures. Snubbers which undergo maintenance or repair activities which could alter the snubber's ability to perform its intended function shall be examined and tested in accordance with the applicable requirements of paragraphs 2.3.1.2 and 3.2.1.1. The requirements selected shall ensure that the function(s) which may be affected are verified by the examination and tests to be performed.

For BFN Unit 3, The alternative requirements for Suubber Maintenance or repair is provided as follows.

0-TI-398, Section 7.18, Rebuilding of Hydraulic Snubbers states: Rebuilding of hydraulic snubbers shall be performed by task qualified and trained persons. Hydraulic snubbers shall be rebuilt in accordance with the MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly, as appropriate. MPI-0-000-SNB002, Section 6.2- states: Rebuilt snubber shall pass functional test criteria in 0-SI-4.6.H-2B.

NRC Request 6

On page 141, in the third paragraph, the licensee stated that snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the site corrective action program, SPP-3.1, and the implementing procedures. Explain how TR 3.7.4 and the other specified documents meet OM Part 4, Section 3.3 requirements.

TVA Response to NRC Request 6

OM Part 4 Section 3.3 Testing Documentation

Documents necessary to verify the result of the pre-service and in-service program shall include, as a minimum:

(a) pre-service operability test procedures and results

(b) In-service operability test procedures and results

(c) Nonconformance results, nonconformance evaluations, and corrective action.

TR 3.7.4 documents the required action, completion time and conditions pertaining to the operability, inspection, testing, and acceptance criteria of snubbers at BFN. Surveillance instructions are utilized to implement the requirements of TR 3.7.4. Plant surveillance instructions 0-SI-4.6.H-2A, 2B, -2C and -2E cover functional testing of all snubbers at BFN. Surveillance instruction 3-SI-4.6.H-1 covers the visual examination of Unit 3 hydraulic and mechanical snubbers. These surveillance instructions document pre-service operability test procedures and results. They also document in-service operability test procedures and results, nonconformance evaluations, and corrective actions. Plant procedure SPP 3.1 is utilized to document when snubbers are found to be outside of testing acceptance criteria or in a nonconforming condition. Surveillance instructions are included in the work package for the snubber and transmitted to permanent record storage (EDMS) after closure of the work package/work order.

NRC Request 7

On Page 141, Justification For The Granting Of Relief, in the second paragraph, the licensee stated that the current program provides for a level of quality and safety equal to or greater than that provided by the OM and utilizes NRC guidance not incorporated into the OM Code. Provide a comparison between various sections of TR 3.7.4 and the OM Part 4 (e.g. Sections 2.1, 2.4, 3.2, and 3.3) and explain how TR 3.7.4 provides a level of quality and safety equal to and greater than that provided by OM Part 4. Also, clarify and provide information regarding the statement "...utilizes guidance not incorporated in the OM Code referenced by the 2001 Edition, 2003 addenda of ASME Section XI." (quotation marks added to facilitate identification)

TVA Response to NRC Request 7

See TVA's response to NRC Request number 3 above.

TVA's reference to guidance not incorporated in the OM Code will be deleted. This referral was to GL 90-09 which is incorporated into the BFN Unit 3 Snubber Program.

NRC Request 8

On Page 141, Justification For The Granting Of Relief, in the second paragraph, the licensee stated that:

> Examination, testing, repair and replacement of snubbers is currently performed in accordance with TR 3.7.4, which utilizes the guidance provided by NRC in GL 90-09. The OM Code referenced by ASME Section XI has a different basis for examination (failure mode groups) and testing plans (10 percent, 37, or 55). It is impractical to implement both plans because of the resulting duplication of examination and testing.

However, GL 90-09 only provides guidance for Snubber Visual Examination Intervals and Corrective Actions. GL 90-09 does not provide guidance for examination and testing plans. Explain how TR 3.7.4 meets the OM-4 Code requirement of examination and testing plans (10 percent, 37, or 55).

TVA Response to NRC Request 8

The proposed BFN Unit 3 examination and testing plan alternatives are provided in TSR 3.7.4.1, TSR 3.7.4.2, and TSR 3.7.4.3. See TVA's response to NRC request number 3 above.

NRC Request 9

On page 141-142, Justification For The Granting Of Relief, in the fourth paragraph, the licensee stated that replacement snubbers and snubbers which have repairs which might affect the functional test results are to be tested to ensure they meet the functional criteria. Explain how TSR 3.7.4.6 meets the intent of Sections 1.5.6 and 1.5.7 of OM Part 4.

TVA Response to NRC Request 9

The proposed alternatives to OM Part 4, Sections 1.5.6, and 1.5.7 are provided in TSR 3.7.4.6 which requires meeting the requirements in TSR 3.7.4.2. The requirements of TSR 3.7.4.2 are implemented by 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, and 0-SI-4.6.H-2E. See TVA's response to NRC request number 5 above for details.

NRC Request 10

On page 142, Justification For The Granting Of Relief, in the second paragraph, the licensee stated that the maintenance procedure provides visual examination criteria for installation of a snubber after repair or replacement. Provide details how the maintenance procedure visual examination requirements are equal to OM Part 4, Section 2.3.1.2 requirements.

TVA Response to NRC Request 10

OM Part 4, Section 2.3.1.2, Visual Examination Requirements states:

The snubber installation must meet the following requirements:

a. **Snubbers shall be installed so that they can carry the load. Visual observation of loose fasteners, deformed members, or detection of disconnected components requires the identification of the installation as unacceptable.**

See TVA's response to NRC request number 3 above.

b. **Snubbers shall be installed in such condition that they do not restrict the thermal movement to the extent that unacceptable overstressing could develop in the pipe or other equipment that the installation is designed to protect or restrain. If no indication of binding, misalignment, or deformation is observed, the provisions of this requirement are considered to be satisfied.**

See TVA's response to NRC request number 3 above.

c. **Special features required for the actuation of the snubber shall be verified. For example, fluid supply or content for hydraulic snubbers shall be observed. Observation that the fluid level is equal to or greater than the minimum amount which is sufficient for actuation at its operating extension is considered to satisfy the provisions of this requirement for hydraulic snubbers. If the fluid is less than the minimum amount, the installation is to be identified as unacceptable unless a test is performed establishing that the performance of the snubber is within specified limits. Tests shall be performed in accordance with paragraphs 3.2.1.1(b) and 3.2.1.1(c) and the initial test shall start with the piston at the as-found setting and be performed in the extension (tension) direction.**

See TVA's response to NRC request number 3 above. Also, 0-TI-398, Appendix A, under Alternate Examinations states: The BFN TRM, TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities. The procedures utilized for these examinations are 3-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers;" 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers;" 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson Hydraulic Snubbers;" 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints;" 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraints;" MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Paterson Unit Disassembly and Reassembly;" and MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers." This will include the pin-to-pin area inclusive of applicable snubbers.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers".

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the site corrective action program, SPP-3.1, and the implementing procedures (3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported will remain in the ASME Section XI examination boundary.

NRC Request 11

On page 142, Justification For The Granting Of Relief, in the third paragraph, the licensee stated that the training and documentation of personnel to the visual acceptance criteria, specified in the TRM implementing procedures provides an acceptable level of quality and safety. Justify this statement and explain how TRM implementing procedures visual training is equal to VT-3 training as required by the OM, Section IWA-2300.

TVA Response to NRC Request 11

The proposed alternative for snubber visual examination training qualification and documentation is provided by 3-SI-4.6.H-1 Step 7.1.1 (1) through (6). The visual acuity requirements of IWA-2320 are satisfied.

NRC Request 12

On page 142, Justification For The Granting Of Relief, in the fourth paragraph the licensee stated that:

> Because relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to require ANII involvement... A snubber program manager provides oversight of the TRM snubber program implementation for both visual examination and functional testing. The snubber program manager provides an acceptable level of quality and safety without ANII involvement in those activities.

Address the training as required by IWA-2300 or alternative method IWA-2317 conducted for the snubber program manager or the person performing snubber inspections.

TVA Response to NRC Request 12

IWA-2300 addresses qualifications of NDE personnel. The snubber program manager and persons performing the snubber inspections meet the visual requirements described by IWA-2300.

NRC Request 13

On Page 142, Justification For Granting Of Relief, in the fifth paragraph, the licensee stated that under the alternative requirements for snubbers, there will be no ASME Section XI inservice examination and testing to document in a summary report and that the Technical Manual requirements are implemented by surveillance instructions. Justify how these specified surveillance instructions are equivalent to the Code requirements of Section IWA-6230 and OM-4, Section 2.3, and 3.3.

TVA Response to NRC Request 13

OM Part 4 Section 2.3.1, Inservice Examination Requirements; Visual Examination for impaired functional ability; Visual Examination Requirements to verify snubbers can carry load, snubbers do not restrict movement, and verification of special features required for actuation.

See TVA response in NRC request number 3, response to OM Part 4 sections 2.1a through 2.1e.

OM Part 4 Section 2.3.2, Inservice Examination Frequency

TSR 3.7.4.1 requires performance of a visual inspection of snubbers with the frequency based on Table 3.7.4-1. Also, see TVA response in NRC request number 3, response to OM Part 4 section 3.2.2.

OM Part 4 Section 2.3.4.1, Failure Evaluation; Section 2.3.4.2, Functional Test Evaluation

See TVA response in NRC request number 3, response to OM Part 4 section 2.4d.

OM Part 4 Sections 2.3.4.3 through 2.3.5.4, which address Failure Mode Groups and Corrective Actions

See TVA response in NRC request number 3, response to OM Part 4 section 3.2.4.2.

OM Part 4 Sections 2.3.5.5, Supported Component(s)/System Evaluation.

See TVA response in NRC request number 3, response to OM Part 4 section 3.2.4.1.

OM Part 4 Section 3.3,

See TVA response to NRC Request 3 above.

IWA-6230 Summary Report Preparation

(a) A preservice inspection summary report shall be prepared prior to commercial service

(b) An inservice inspection summary report shall be prepared at the completon of the inservice inspection conducted during a refuelilng outage. Examinations, test, and repair/replacement activities conducted since the preceding summary support shall be included:

(c) Each summary report required by IWA-6230(a) or (b) shall contain the following:

(1) interval, period and refueling outage number (when applicable)

(2) Owner's report for Inservice Inspections , Form NIS-1, as shown in Appendix II

0-TI-398, Appendix A states: Under the alternate requirements for snubbers, there will be no ASME Section XI inservice examination and testing to document in a summary report. TR 3.7.4 is implemented by surveillance instructions 3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and maintenance instructions MPI-0-000-SNB002, and MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program, includes data sheets for documenting the visual examination and functional test data and results, and provides for documentation of non conforming results and evaluation of those results. The completed data sheets are QA records and are controlled and maintained in accordance with the BFN QA records program. These records are available onsite for review and inspection. The QA records documenting snubber visual examinations and functional tests provide an acceptable level of quality and safety when compared to the requirements of ASME Section XI and OM-1987, Part 4.

(3) Owner's Report for Repair Replacement Activities, Form NIS-2, as shown in Appendix II - ASME XI snubber repair replacement.
(d) Summary sheets shall have a cover sheet providing the following:

(1) Date of document completion
(2) Name and address of Owner
(3) Name and address of plant
(4) Name and number designation of the unit
(5) Commercial service date for the unit

Completed data packages from 0-SI-4.6.H.2A, 0-SI-4.6.H.2B, and 0-SI-4.6.H-2C are permanent plant records prepared and stored in accordance with the TVA QA Program requirements.

NRC Request 14

The TRM does not the address the requirements of OM Part 4, Section 2.3.4 "Inservice Examination Failure Evaluation." Explain how the TRM meets this requirement.

TVA Response to NRC Request 14

OM Part 4, Section 2.3.4.1, Failure Evaluation.
Snubbers which fail to meet the examination acceptance criteria shall be evaluated to determine the cause of the unacceptability

TRM section TSR 3.7.4.1 states: Snubbers which appear inoperable as a result of visual inspection shall be classified unacceptable and may be reclassified acceptable for the purpose of establishing the next visual inspection interval, provided that (1) the cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible; and (2) the affected snubber is functionally tested in the as-found condition and determined OPERABLE per the criteria of TSR 3.7.4.2. A review and evaluation shall be performed and documented to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the system or train shall be declared inoperable.

Additionally, TRM section TSR 3.7.4.3 states: A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of the failure.

OM Part 4, Section 2.3.4.2, Functional Test Evaluation - The snubber(s) that is found to be unacceptable as a result of inservice examination may be tested in accordance with requirements of paragraph 3.2, provided the testing can resolve the unacceptable condition. Results which satisfy the operability test criteria may be used to re-categorize the snubber(s) as acceptable.

See TVA's response above regarding OM Part 4, Section 2.3.4.1.

OM Part 4, Section 2.3.4.3, Examination Failure Mode Groups - Unacceptable snubbers shall be categorized into examination failure mode groups. An examination failure mode group shall include all unacceptable snubbers which have a given failure and all other snubbers subject to the same failure, except as permitted to be considered separately under paragraph 1.6. The examination failure mode groups shall be distinct for examination purposes from any testing failure mode groups. The following examination failure mode groups shall be used:

(a) Design/manufacturing
(b) Application induced
(c) Maintenance/repair/installation
(d) Isolated
(e) Unexplained

The BFN snubber program does not categorize examination failures into failure mode groups, although as reported in the above response to OM Part 4, Section 2.3.4.1, the cause of all examination failures is established and remedied for that particular snubber and for other snubbers that may be generically susceptible.

OM Part 4, Section 2.3.4.4, Examination Failure Mode Group Boundaries. Once an examination failure mode group has been established, any snubber(s) in that examination failure mode group(s) will not be part of the examination group(s) from which the snubber originated except as noted in paragraph 2.3.4.5 below. The new examination failure mode group will remain as defined until:

(a) the examination failure mode group has reached the maximum time interval allowed

(b) replacement/modification action in accordance with paragraphs 2.3.5.1(a) or (c), or paragraph 2.3.5.2 provides an examination failure group with all acceptable snubbers.

See TVA's response above regarding OM Part 4, Section 2.3.4.3.

OM Part 4, Section 2.3.4.5, Snubbers in More Than One Failure Group - Any snubber(s) which is in more than one examination failure mode group, the examination schedule for that snubber will be determined by the examination failure mode group with the shortest examination schedule.

See TVA's response above regarding OM Part 4, Section 2.3.4.3.

Based on the information provided above, TVA feels that the alternate BFN Unit 3 examination and testing of snubbers program, in accordance with TR 3.7.4, will provide an acceptable level of quality and safety.

Attachment A

BFN UNIT 3 TECHNICAL REQUIREMENTS MANUAL,

SECTION 3.7.4, (with Bases)

Snubbers

TR 3.7 PLANT SYSTEMS

TR 3.7.4 Snubbers

LCO 3.7.4 During all MODES of operation, all snubbers shall be OPERABLE. All safety-related snubbers are listed in plant procedures.

APPLICABILITY: MODES 1, 2, 3, 4, 5 when the associated system/component is required to be OPERABLE.

-----NOTE-----
Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping, in the drywell, are exempt from the operability requirement when the steam line plugs are installed in the reactor vessel.

ACTIONS

-----NOTE-----
Separate condition entry is allowed for each system/train - not per snubber.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable.	A.1.1 Replace or restore the inoperable snubber(s) to OPERABLE status. AND	72 hours
		(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable (continued).	----------------NOTES---------------- 1. Only required if the snubber(s) do not meet the functional test acceptance criteria of TSR 3.7.4.2. 2. The evaluation must ensure the inoperable snubber did not adversely affect the supported component or system during the previous operating cycle. ---	
	A.1.2 Perform an engineering evaluation to determine whether the snubber failure mode has adversely affected the supported component or system.	72 hours
	<u>OR</u>	
	A.2 Verify operability of the supported system based on an engineering evaluation of its functional capability with the inoperable snubber(s).	72 hours
	<u>OR</u>	(continued)

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more snubber(s) inoperable (continued).	A.3.1 Declare the supported system inoperable. (Refer to applicable TS and TRM LCOs). AND ----------------NOTE------------------ Only applicable to snubbers located inside the drywell on reactor vessel attached piping. --	72 hours
	A.3.2 Be in MODE 4 or 5.	108 hours
B. Supported system declared inoperable due to one or more inoperable snubbers.	----------------NOTES---------------- 1. Only applicable while in MODE 4 or 5. 2. Only applicable to snubbers located inside the drywell on reactor vessel attached piping. (Excluding MS, HPCI, and RCIC piping when the steam line plugs are installed in the reactor vessel.). --	
	B.1 Verify by administrative means that two ECCS subsystems are in OPERABLE status.	4 hours
C. Required Action and associated Completion Time B not met.	C.1 Initiate action to restore two ECCS subsystems to OPERABLE status.	Immediately

NOTES

1. Each safety-related snubber shall be demonstrated OPERABLE by performance of the following augmented inservice inspection and test program and the requirements of this Technical Requirement. These snubbers are listed in plant procedures.
2. As used in this Technical Requirement, "type of snubber" shall mean snubbers of the same design and manufacturer, irrespective of capacity.
3. As used in this Technical Requirement, "population or category" shall mean the total number of snubbers being visually inspected as a lot.

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1	NOTE Snubbers are categorized as inaccessible or accessible during reactor operations. Each of these categories (inaccessible or accessible) may be inspected separately or jointly according to the schedule determined by Table 3.7.4-1. The visual inspection interval for a snubber population or category shall be determined based upon the criteria provided by Table 3.7.4-1. The first inspection interval determined using Table 3.7.4-1 criteria shall be based on the previous inspection interval established by the requirements in effect before Technical Specification Amendment 183 was issued.	
	Perform visual inspection of required snubber(s) based on the criteria of Table 3.7.4-1 for each population or category to verify: a. No visible indications of damage or impaired OPERABILITY; b. Attachments to the foundation or supporting structure are functional; and	In accordance with Table 3.7.4-1

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1 (continued)	c. Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. Snubbers which appear inoperable as a result of visual inspection shall be classified unacceptable and may be reclassified acceptable for the purpose of establishing the next visual inspection interval, provided that (1) the cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible; and (2) the affected snubber is functionally tested in the as-found condition and determined OPERABLE per the criteria of TSR 3.7.4.2. A review and evaluation shall be performed and documented to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the system or train shall be declared inoperable. Additionally, snubbers attached to sections of safety related systems that have experienced unexpected potentially damaging transients since the last inspection period shall be evaluated for the possibility of concealed damage and functionally tested, if applicable, to confirm OPERABILITY. Snubbers which have been made inoperable as the result of unexpected transients, isolated damage, or other random	

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.1 (continued)	events, when the provisions of TSR 3.7.4.5 and TSR 3.7.4.6 have been met and any other appropriate corrective action implemented, shall not be counted in determining the next visual inspection interval.	
TSR 3.7.4.2	Perform an in-place or bench functional test of a representative sample of 10% of the total of each type of safety-related snubber(s). a. The representative sample selected for functional testing shall include the various configurations, operating environments, and the range of size and capacity of snubbers within the types; b. The representative sample should be weighed to include more snubbers from severe service areas such as near heavy equipment; c. The stroke setting and the security of fasteners for attachment of the snubbers to the component or system and to the snubber anchorage shall be verified.	24 months

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
TSR 3.7.4.2 (continued)	Functional Test Acceptance Criteria: The snubber functional test shall verify that: a. Activation (restraining action) is achieved in both tension and compression within the specified range, except that inertia dependent, acceleration limiting mechanical snubbers may be tested to verify only that activation takes place in both directions of travel. b. Snubber bleed or release, where required, is present in both compression and tension within the specified range. c. For mechanical snubbers, the force required to initiate or maintain motion of the snubber is not great enough to overstress the supported component or system during thermal movement, or to indicate impending failure of the snubber. d. For snubbers specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be verified. e. Testing methods may be used to measure parameters indirectly or parameters other than those specified if those results can be correlated to the specified parameters through established methods.	

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
TSR 3.7.4.3	A failure analysis shall be made of each failure to meet the functional test acceptance criteria of TSR 3.7.4.2 to determine the cause of the failure. The result of this analysis shall be used, if applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers which may be subject to the same failure mode. Selection of snubbers for future testing may also be based on the failure analysis. For each failed snubber, perform in-place or bench functional test on an additional lot equal to 10% of the remainder of that type of snubber. Testing shall continue until no additional inoperable snubbers are found within subsequent lots or all snubbers of the original test type are tested or all suspect snubbers identified by the failure analysis have been tested, as applicable. The functional test criteria shall be as specified in TSR 3.7.4.2.	Once for each discovery of snubber failure to meet functional test acceptance criteria
	Prior to functional testing the discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. The result of the evaluation will be used to select other suspect snubbers for verifying the attachment fasteners, as applicable.	Once for each discovery of loose or missing attachment fasteners

(continued)

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
TSR 3.7.4.4	------------------------NOTE------------------------ This testing is independent of the requirements of TSR 3.7.4.3. -- For any snubber which fails to lockup or fails to move (i.e., frozen in place), evaluate the cause. If caused by manufacturer or design deficiency, perform in-place or bench functional test of all snubbers of the same design, subject to the same defect. The functional test acceptance criteria shall be as specified in TSR 3.7.4.2.	Once for each discovery of snubber failure to lockup or failure to move
TSR 3.7.4.5	Perform an engineering evaluation on the component or system which is restrained by the snubber(s) found inoperable due to not meeting their functional test acceptance criteria as specified in TSR 3.7.4.2.	Once for each discovery of an inoperable snubber
TSR 3.7.4.6	Verify replacement snubbers and snubbers having repairs which might affect the functional test results meet the test criteria of TSR 3.7.4.2. a. These snubbers shall have met the acceptance criteria subsequent to their most recent service; and b. The functional test must have been performed within the 12 months prior to being installed in the unit.	Once prior to installation in the unit for each replacement snubber and each snubber which has repairs which might affect functional test results

Table 3.7.4-1
Snubber Visual Inspection Interval

	NUMBER OF UNACCEPTABLE SNUBBERS		
Population or Category (Notes 1 and 2)	Column A Extend Interval (Notes 3 and 6)	Column B Repeat Interval (Notes 4 and 6)	Column C Reduce Interval (Notes 5 and 6)
1	0	0	1
80	0	0	2
100	0	1	4
150	0	3	8
200	2	5	13
300	5	12	25
400	8	18	36
500	12	24	48
750	20	40	78
1000 or more	29	56	109

Note 1: The next visual inspection interval for a snubber population or category size shall be determined based upon the previous inspection interval and the number of unacceptable snubbers found during that interval. Snubbers may be categorized, based upon their accessibility during power operation, as accessible or inaccessible. These categories may be examined separately or jointly. However, the licensee must make and document that decision before any inspection and shall use that decision as the basis upon which to determine the next inspection interval for that category.

Note 2: Interpolation between population or category sizes and the number of unacceptable snubbers is permissible. Use next lower integer for the value of the limit for Columns A, B, or C if that integer includes a fractional value of unacceptable snubbers as determined by interpolation.

Table 3.7.4-1 (Continued)
Snubber Visual Inspection Interval

Note 3: If the number of unacceptable snubbers is equal to or less than the number in Column A, the next inspection interval may be twice the previous interval but not greater than 48 months.

Note 4: If the number of unacceptable snubbers is equal to or less than the number in Column B but greater than the number in Column A, the next inspection interval shall be the same as the previous interval.

Note 5: If the number of unacceptable snubbers is equal to or greater than the number in Column C, the next inspection interval shall be two-thirds of the previous interval. However, if the number of unacceptable snubbers is less than the number in Column C, but greater than the number in Column B, the next interval shall be reduced proportionally by interpolation, that is, the previous interval shall be reduced by a factor that is one-third of the ratio of the difference between the number of unacceptable snubbers found during the previous interval and the number in Column B to the difference in the numbers in Columns B and C.

Note 6: The provisions of TSR 3.0.1, 3.0.2, and 3.0.3 are applicable for all inspection intervals up to and including 48 months.

TR 3.7 PLANT SYSTEMS

TR 3.7.4 Snubbers

BASES

BACKGROUND	Snubbers are designed to prevent unrestrained component or system motion under dynamic loads as might occur during an earthquake or severe transient, while allowing normal thermal motion during startup and shutdown. The consequence of an inoperable snubber is an increase in the probability of structural damage to the component or system as a result of a seismic or other event initiating dynamic loads. An inoperable snubber (ex: failed by locked in place) may cause damage to the supported component or system from normal operating modes such as thermal operation. It is, therefore, required that all snubbers required to protect the primary coolant system or any other safety related component or system be OPERABLE during MODES 1, 2, 3, 4, and 5. The Technical Requirements Manual (TRM) action statements establish allowable outage times for components or systems addressed by the Limiting Conditions of Operation (LCO) for snubbers. These time limits are applicable when a snubber must be removed from service to perform required surveillance tests. For snubbers, the allowable outage time is 72 hours. Table 3.7.4-1, "Snubber Visual Inspection Interval" was issued to all nuclear plant license holders by the Nuclear Regulatory Commission (NRC) under Generic Letter (GL) 90-09. This was added to the old Technical Specification and approved by the NRC under Technical Specification Amendment 183.
APPLICABLE SAFETY ANALYSIS	During MODES 1, 2, 3, 4, and 5 snubbers may be removed from service for functional surveillance testing to satisfy the required testing interval. When a snubber is removed from a component or system, the snubber is declared inoperable since it cannot perform its intended function while removed. This type of inoperability is not a failure and does not require an engineering evaluation to be performed. Examples of snubber failures include locked in place, high drag force, does not activate, no lockup, high lockup, low lockup, high bleed, no bleed, and damage to the snubber hardware. If a snubber is determined to be inoperable based on failure to meet the functional test acceptance criteria, an engineering evaluation is performed to establish whether, during

BASES

APPLICABLE SAFETY ANALYSIS (continued)	the previous unit operating cycle, the mode of failure of the snubber has adversely affected the supported component or system. This engineering evaluation does not relate to the component or system capability to withstand a seismic event or severe transient. A limited amount of time (72 hours) is allowed for the supported component or system to be considered OPERABLE with one or more inoperable snubbers. Any degradation in seismic or dynamic protection due to the inoperable snubber(s) was taken into account in establishing the 72 hour completion time.
LCO 3.7.4	During all MODES of operation, all snubbers shall be OPERABLE. The number of snubbers on each unit and shared systems at BFN are too numerous to list in this Technical Requirement. The surveillance 4.6.H series lists the snubbers that are required.
APPLICABILITY	During all MODES of operation, all snubbers shall be OPERABLE. All MODES are applicable for this requirement since the snubbers affect a wide variety of components and systems, of which some of the systems are required in one or more MODES of operation. All MODES are covered since every MODE will be applicable for one or more of the supported components or systems. However, if a component or system affected by the snubber is not required to be OPERABLE, then the snubber is not required to be OPERABLE, except as follows: the snubbers located inside the drywell on reactor vessel attached piping systems shall be considered OPERABLE whenever fuel is in the reactor vessel. The snubbers on Main Steam, HPCI, and RCIC piping in the drywell are exempt from this requirement when the steam line plugs are installed inside the reactor vessel. During the times the snubbers are not required to be OPERABLE for an inoperable system, the inoperable snubber(s) will be tracked to prevent declaring the system OPERABLE with unanalyzed inoperable snubbers.

ACTIONS

A.1.1, A.1.2, A.2, A.3.1 and A.3.2

Required Action A.1.2 directs performance of an engineering evaluation of the supported component or system if a snubber is inoperable due to failure to meet the functional test acceptance criteria of TSR 3.7.4.2. The purpose of this engineering evaluation is to determine whether the mode of failure of the snubber has adversely affected the supported component or system during the previous unit operating cycle. This evaluation is not intended to assess the capability of the component or system to withstand a seismic event or severe transient with the inoperable snubber(s). Required Action A.1.2 is not applicable in instances where a snubber is declared inoperable only because it has been removed for testing.

Required Action A.2, which is an alternative to A.1.1 and A.1.2, requires verification that the supported system remains OPERABLE with the inoperable snubber(s). The operability status shall be determined based on an engineering evaluation of the functional capabilities of the supported system, and shall consider all design basis events, accidents, and transients. The evaluation shall also consider whether the mode of failure of the snubber has adversely affected the supported system during the previous unit operating cycle.

Since the protection provided by snubbers is required only during relatively low probability events, a period of 72 hours is allowed to complete Required Actions A.1.1 and A.1.2, or A.2. If the 72 hour time limit for these Required Actions cannot be met, Required Action A.3.1 stipulates that the supported system shall be declared inoperable. (The supported system is the system or subsystem on which the snubber is installed.) Additionally, if the inoperable snubber is located inside the drywell on reactor vessel attached piping, Required Action A.3.2 mandates that the reactor be placed in MODE 4 or 5 within 108 hours. This requirement reflects the greater safety significance of snubbers providing protection to portions of the reactor coolant boundary. By placing the reactor in MODE 4 or 5, the potential consequences and importance to safety of an inoperable snubber attached to reactor coolant boundary

ACTIONS

A.1.1, A.1.2, A.2, A.3.1 and A.3.2 (continued)

piping will be substantially diminished. The 108 hour Completion Time allows 36 hours to reach cold shutdown after expiration of the 72 hour Completion Time associated with Required Action A.3.1. This time period was selected to ensure that prompt action is taken, while also providing sufficient time for an orderly shutdown without challenging plant systems.

B.1 and C.1

Condition B is entered once the supported system is declared inoperable due to one or more inoperable snubbers. It is only applicable while in MODE 4 or 5, and only for snubbers located inside the drywell on reactor vessel attached piping.

Required Action B.1 specifies verification, by administrative means, that two ECCS subsystems are in OPERABLE status. This requirement is meant to provide assurance that reactor coolant makeup capability is available to mitigate an earthquake generated pipe break within the reactor coolant boundary. The four hour completion time is judged to be adequate considering that the reduced temperatures and pressures associated with MODES 4 and 5 increases the capability of the piping to withstand an earthquake, and thereby decreases the already low probability of an earthquake induced pipe break.

If two ECCS subsystems are not available, the Required Action and Completion Time of Condition C require that actions be initiated immediately to restore the two ECCS subsystems to OPERABLE status.

TECHNICAL SURVEILLANCE REQUIREMENTS

A note is provided to indicate that each safety-related snubber (listed in plant procedures) shall be demonstrated OPERABLE by performance of the augmented inservice inspection program and requirements of this Technical Requirement.

An additional note is provided to indicate that in this Technical Requirement, "type of snubber" shall mean snubbers of the same design and manufacturer, irrespective of capacity.

The augmented inservice inspection program includes the following.

All safety-related snubbers are visually inspected for overall integrity and OPERABILITY. The visual inspection will include verification of proper orientation, adequate fluid level, if applicable, no visible indications of damage or impaired OPERABILITY, proper attachment of the snubber to the component or system and structures, and no loose or missing fasteners. The removal of insulation or the verification of torque values for threaded fasteners is not required for visual inspections.

The visual inspection frequency is based upon maintaining a constant level of snubber protection. In accordance with Table 3.7.4-1, the number of inoperable snubbers found during a required inspection determines the time interval for the next required inspection. Inspections performed before that interval has elapsed may be used as a new reference point to determine the next inspection. However, the results of such early inspections performed before the original required time interval has elapsed (nominal time less 25 percent) may not be used to lengthen the required inspection interval. Any inspection whose results require a shorter inspection interval will override the previous schedule.

When the cause of the rejection of a snubber in a visual inspection is clearly established and remedied for that snubber and for any other snubber(s) that may be generically susceptible and OPERABILITY verified by inservice functional testing, if applicable, that snubber(s) may be reclassified as OPERABLE. Generically susceptible snubbers are those which are of a specific make or model and have the same design features directly related to the rejected snubber, or are similarly located or exposed to the same environmental conditions such as temperature, radiation, and

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

vibration. The inspection population or category may be established based on design features, or installed conditions which may be expected to be generic. Each of these inspection populations or categories may be inspected and tested separately unless an engineering analysis indicates the inspection population or category is improperly constituted. All suspect snubbers are subject to inspection and testing regardless of inspection population or category.

To verify snubber OPERABILITY, a functional test shall be performed once per 24 months.

These tests will include stroking of the snubbers to verify proper movement, activation, and bleed or release. Ten percent represents an adequate sample for such tests. Observed failures on these samples will require a failure analysis and testing of additional units. If the failure analysis results in the determination that the failure of a snubber to activate or to stroke (i.e., seized components) is the result of a manufacture or design deficiency, all snubbers subject to the same defect shall be functionally tested. Also, an engineering evaluation shall be performed to determine the effects on the supported component or system during the previous unit operating cycle with the snubber inoperable, and to ensure it remains capable of meeting its designed service. A thorough visual inspection of the snubber threaded attachments to the component or system and the anchorage will be made in conjunction with all required functional tests. The stroke setting of the snubbers selected for functional testing also will be verified.

Exemption from Visual Inspection or Functional Tests:

Permanent or other exemptions from visual inspections and/or functional testing for individual snubbers may be granted by the Nuclear Regulatory Commission if a justifiable basis for exemption is presented and if applicable snubber life destructive testing was performed to qualify the snubber OPERABILITY for the applicable design conditions at either the completion of their fabrication or at a subsequent date. Snubbers so exempted shall continue to be listed in the plant instructions with footnotes indicating the extent of the exemptions.

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)

Snubber Service Life Program:

The service life of snubbers may be extended based on an evaluation of the records of functional tests, maintenance history, and environmental conditions to which the snubbers have been exposed.

The following will be implemented by the augmented inservice inspection program:

TSR 3.7.4.1

Visual Inspections:

Snubbers are categorized as inaccessible or accessible during reactor operation. Each of these populations or categories (inaccessible or accessible) may be inspected separately or jointly according to the schedule determined by Table 3.7.4-1. The visual inspection interval for a snubber population or category shall be determined based upon the criteria provided by Table 3.7.4-1. The first inspection interval determined using Table 3.7.4-1 criteria shall be based on the previous inspection interval as established by the requirements in effect before Technical Specification Amendment No. 183 was issued.

Visual Inspection Acceptance Criteria:

Visual inspections shall verify that (1) the snubber has no visible indications of damage or impaired OPERABILITY, (2) attachments to the foundation or supporting structure are functional, and (3) fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional.

Snubbers which appear inoperable as a result of visual inspection shall be classified unacceptable and may be reclassified acceptable for the purpose of establishing the next visual inspection interval, provided that (1) the cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers, irrespective of type, that may be generically susceptible; and (2) the affected snubber is functionally tested in the as-found condition and determined OPERABLE per the functional test acceptance criteria of TSR 3.7.4.2.

TECHNICAL SURVEILLANCE REQUIREMENTS

TSR 3.7.4.1 (continued)

A review and evaluation shall be performed and documented to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the snubber shall be declared inoperable.

Additionally, snubbers attached to sections of safety-related systems that have experienced unexpected potentially damaging transients since the last inspection period shall be evaluated for the possibility of concealed damage and functionally tested, if applicable, to confirm OPERABILITY. Snubbers which have been made inoperable as the result of unexpected transients, isolated damage, or other random events, when the provisions of TSR 3.7.4.5 and 3.7.4.6 have been met and any other appropriate corrective action implemented, shall not be counted in determining the next visual inspection interval.

TSR 3.7.4.2

Functional Test Schedule, Lot Size, and Composition:

Once per 24 months, a representative sample of 10% of the total of each type of safety-related snubbers in use in the plant shall be functionally tested either in place or in a bench test.

The representative sample selected for functional testing shall include the various configurations, operating environments, and the range of size and capacity of snubbers within the types. The representative sample should be weighed to include more snubbers from severe service areas such as near heavy equipment. The stroke setting and the security of fasteners for attachment of the snubbers to the component or system and to the snubber anchorage shall be verified on snubbers selected for functional tests.

TECHNICAL SURVEILLANCE REQUIREMENTS

TSR 3.7.4.2 (continued)

Functional Test Acceptance Criteria:

The snubber functional test shall verify that:

a. Activation (restraining action) is achieved in both tension and compression within the specified range, except that inertia dependent, acceleration limiting mechanical snubbers may be tested to verify only that activation takes place in both directions of travel.

b. Snubber bleed, or release where required, is present in both compression and tension within the specified range.

c. For mechanical snubbers, the force required to initiate or maintain motion of the snubber is not great enough to overstress the supported component or system during thermal movement, or to indicate impending failure of the snubber.

d. For snubbers specifically required not to displace under continuous load, the ability of the snubber to withstand load without displacement shall be verified.

e. Testing methods may be used to measure parameters indirectly or parameters other than those specified if those results can be correlated to the specified parameters through established methods.

TSR 3.7.4.3

Functional Test Failure Analysis and Additional Test Lots:

A failure analysis shall be performed for each failure to meet the functional test acceptance criteria to determine the cause of the failure. The result of this analysis shall be used, if applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers which may be subject to the same failure mode. Selection of snubbers for future testing may also be based on the failure analysis.

TECHNICAL SURVEILLANCE REQUIREMENTS

TSR 3.7.4.3 (continued)

For each snubber that does not meet the functional test acceptance criteria, an additional lot equal to 10 percent of the remainder of that type of snubber(s) shall be functionally tested. Testing shall continue until no additional inoperable snubbers are found within subsequent lots or all snubbers of the original functional test type have been tested or all suspect snubbers identified by the failure analysis have been tested, as applicable.

The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic. The result of the evaluation will be used to select other suspect snubbers for verifying the attachment fasteners, as applicable.

TSR 3.7.4.4

If any snubber selected for functional testing either fails to lockup or fails to move, i.e., frozen in place, the cause will be evaluated and if caused by manufacturer or design deficiency, all snubbers of the same design, subject to the same defect, shall be functionally tested. This testing requirement shall be independent of the requirements stated above for snubbers not meeting the functional test acceptance criteria.

TSR 3.7.4.5

Functional Test Failure - Supported Component or System Analysis:

For the snubber(s) found inoperable, an engineering evaluation shall be performed on the component or system which is restrained by the snubber(s) due to not meeting their functional test acceptance criteria. The purpose of this engineering evaluation shall be to determine if the component or system restrained by the snubber(s) was adversely affected by the inoperability of the snubber(s), and in order to ensure that the restrained component or system remains capable of meeting the designed service.

TECHNICAL SURVEILLANCE REQUIREMENTS (continued)	<u>TSR 3.7.4.6</u> Functional Testing of Repaired and Spare Snubbers: Snubbers which fail the visual inspection or the functional test acceptance criteria shall be repaired or replaced. Replacement snubbers and snubbers having repairs which might affect the functional test results shall meet the functional test acceptance criteria before installation in the unit. These snubbers shall have met the acceptance criteria subsequent to their most recent service, and the functional test must have been performed within 12 months prior to being installed in the unit.
REFERENCES	1. BFN Technical Specifications (version prior to standardized version)

Attachment B

BFN SURVEILLANCE INSTRUCTION

3-SI-4.6.H-1,

Visual Examination of Hydraulic and Mechanical Snubbers

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

SURVEILLANCE INSTRUCTION

3-SI-4.6.H-1

VISUAL EXAMINATION OF HYDRAULIC AND MECHANICAL SNUBBERS

REVISION 35

PREPARED BY: B. M. PEDROSO JR. PHONE: 3177

RESPONSIBLE ORGANIZATION: SITE ENGINEERING-CIVIL DESIGN

APPROVED BY: Eric J. Frevold DATE: 08/02/2006

EFFECTIVE DATE: 08/02/2006

LEVEL OF USE: CONTINUOUS USE

QUALITY-RELATED

REVISION LOG

Procedure Number: 3-SI-4.6.H-1 Revision Number: 35

Pages Affected: Cover sheet, Revision Log, 4, 5, 6, 17, 18, 20, and 30.

Description of Change: IC-37

This procedure is being revised clarify visual examination statements contained in the checklist, to update the ASME Section XI Edition year to 2001 and add in 2003 Addenda.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) (TR) 3.7.4, and provides direction for the visual examination of hydraulic and mechanical snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety-related systems, inside and outside of the drywell.

1.2 Scope

NOTES:

(1) For the purposes of this instruction, all snubbers are combined as one population. The snubbers are listed in Appendix A by the manufacturer and sizes which are required for the functional testing requirements.

(2) As used in this instruction, "type of snubber" shall mean snubbers of the same design and manufacturer, irrespective of capacity.

(3) The remaining portions of Technical Requirements 3.7.4 pertain to the functional testing of snubbers and are implemented by Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, and 0-SI-4.6.H-2E.

1.2.1 This Surveillance Instruction (SI) includes provision for as-found functional testing to establish operability of snubbers which appear inoperable as a result of the visual examination.

1.2.2 Guidance to Perform the Visual Examination

This Surveillance Instruction (SI) provides the requirements and guidance to perform the visual examinations of all snubbers for UNIT 3 as follows:

1.2.2.1 Provides the requirements to completely fulfill the Technical Requirements Manual (TRM) visual examination of all snubbers. The interval will be as required by TR 3.7.4, Table 3.7.4-1.

1.2.2.2 Provides a means for the control and documentation of all snubber visual surveillance activities provided in this Surveillance Instruction.

2.0 REFERENCES

2.1 Technical Requirements Manual (TR 3.7.4), Snubbers.

2.2 Plant Instructions

0-SI-4.6.H-2A, Functional Testing of Mechanical Snubbers.

0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers.

0-SI-4.6.H-2C, Functional Testing of Bergen-Paterson Torus Dynamic Restraints.

0-SI-4.6.H-2E, Functional Testing of Lisega Torus Dynamic Restraint Snubbers

MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly.

MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Snubbers.

0-TI-398, Snubber Program Procedure

SPP-3.1, Corrective Action Program

SPP-8.1, Conduct of Testing

2.3 Relief Request 3-ISI-2 (TAC NO. M97805), dated May 3, 1999 NRC Letter, "Browns Ferry Nuclear Plant, Unit 3 - Relief From ASME Boiler and Pressure Vessel Code, Section XI Requirements.

3.0 PRECAUTIONS AND LIMITATIONS

NONE

4.0 PREREQUISITES

NONE

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

5.1 Length Measuring Scales, M&TE Measuring Test Equipment for Torus Restraints

5.2 Inspection Mirrors, as required

5.3 GE SF 1154 Silicon Fluid, as required (To be used for all snubbers except the LISEGA Torus Dynamic Restraints).

5.4 LISEGA AP-280 Silicon Fluid, as required (To be used only in the LISEGA Torus Dynamic Restraints).

5.5 Calibrated Thermometer, M&TE Measuring Test Equipment for Bergen-Paterson Torus Restraints

6.0 ACCEPTANCE CRITERIA

6.1 Responses which fail to meet the following acceptance criteria require immediate notification of the Snubber Engineer/SE Designee at the time of failure.

6.1.1 Visual examinations shall verify:

(1) The snubber has no visible indications of damage or impaired operability.

(2) Attachments to the foundation or supporting structure are functional.

(3) Fasteners for the attachment of the snubber to the component or system and to the snubber anchorage are functional. The discovery of loose or missing attachment fasteners will be evaluated to determine whether the cause may be localized or generic.

(4) The snubber has the proper orientation, and adequate fluid level, if applicable.

7.0 PROCEDURE STEPS

7.1 Training and Qualifications of Performers

7.1.1 Visual Examinations

(1) A thorough briefing should be conducted on SI performance prior to starting.

(2) The performer or cognizant individual responsible for the performance of the Surveillance Instruction must be task qualified.

(3) Appropriate General Employee Training (GET) (including respirator training) should be received by the examining personnel prior to performing this SI.

(4) The training for the visual examinations should include orientation to the requirements of this Surveillance Instruction and will be performed under task number MMY 501, as required.

(5) Personnel performing this visual examination must meet the visual acuity requirements of ASME Section XI, 2001 Edition, 2003 Addenda, Paragraph IWA-2321.

(6) Documentation shall be maintained by the Snubber Engineer for the Visual Acuity Examinations.

7.2 General Information

7.2.1 Snubbers which appear inoperable as a result of visual examination shall be classified unacceptable and may be reclassified as acceptable for the purpose of establishing the next visual examination interval, provided that:

(1) The cause of the rejection is clearly established and remedied for that particular snubber and for other snubbers irrespective of type that may be generically susceptible, and

(2) The affected snubber is functionally tested in the as-found condition and determined OPERABLE per the as-found acceptance criteria for that snubber.

A review and evaluation shall be performed and documented in Attachment 3, 4, or 5 as applicable, to justify continued operation with an unacceptable snubber. If continued operation cannot be justified, the snubber shall be declared inoperable and the LIMITING CONDITIONS OF OPERATION (LCO) for the system shall be met.

7.2.2 Snubbers attached to sections of safety-related systems that have experienced unexpected potentially damaging transients since the last examination period shall be evaluated for the possibility of concealed damage and functionally tested, if applicable, to confirm OPERABILITY.

7.2.3 Snubbers which have been made inoperable as the result of an unexpected transient, isolated damage, or other random events, when the provisions of TSR 3.7.4.5 and TSR 3.7.4.6 have been met and any other appropriate corrective action implemented, shall not be counted in determining the next visual examination interval.

NOTE: The snubbers may be divided into accessible or inaccessible categories, and they may be inspected together or separately. For the purpose of performing this SI, all snubbers are classified as one category.

7.2.4 A Surveillance Instruction Review Form, Attachment 1, shall be completed and submitted with the data package for each complete or partial performance of this SI.

7.2.5 All visual examinations shall be performed and documented on Attachment 2A, 2B, 2C, and 6, as applicable prior to removal of each snubber for the As-Found functional testing. The Attachments shall be submitted with the data package.

7.2.6 Evaluation sheets (Attachments 3, 4, and 5) shall be prepared and submitted with the data package, as appropriate, by the Snubber Engineer/SE-Designee for each degraded/inoperable snubber identified by performance of this instruction.

7.2 General Information (Continued)

7.2.7 The snubbers are assigned a UNID number in an appropriate tracking program, which provides current and historical information for a specific snubber/support location.

7.2.8 The snubbers are listed in Appendix A by exam number.

7.2.9 A unique snubber/support number is given to each snubber location on a system.

7.3 Examination Instructions, Acceptance Criteria and Data Entry

7.3.1 Package Preparation and Evaluation

NOTES:

(1) The operability of the snubber is determined based on the examinations performed and further evaluations which may include a functional test. If it is determined that the snubber does not meet the visual examination acceptance criteria, immediately notify the Snubber Engineer/SE-Designee.

(2) If further evaluations, which may include a functional test, are acceptable, the snubber is operable.

(3) The snubber is not counted as inoperable, and the examination interval is not shortened if the snubber is proven operable by the functional test.

7.3.1.1 If any snubber is determined to be inoperable, Site Engineering Civil should INITIATE a Problem Evaluation Report (PER). MMG Planning should write a minor maintenance Work Order (WO) to perform the necessary repairs required to return the inoperable snubber to operable status.

7.3.1.2 At the discretion of the Snubber Engineer/SE Designee, FUNCTIONALLY TEST snubbers which appear to be inoperable by visual examination to establish operability if the unacceptable indication relates to the internal functioning of the snubber. This shall be documented on Attachment 4 or 5, as appropriate.

7.3.1.3 Functional tests shall be performed in accordance with 0-SI-4.6.H-2A, -2B, -2C, or -2E.

7.3.1.4 NOTIFY Site Engineering Civil to perform an engineering evaluation for any inoperable snubber.

7.3.1.5 An "AC", "UNAC", or "N/A" entry must be provided in the appropriate space, on Attachment 2A, 2B or 2C, as appropriate, for every snubber scheduled for examination per this SI.

7.3 Examination Instructions, Acceptance Criteria and Data Entry (Continued)

7.3.1.6 VERIFY Attachment 1, 2A, 2B, 2C, and other appropriate Attachments, have been reviewed by the Snubber Engineer or SE Designee from Site Engineering Civil, prior to closure of this Surveillance Instruction.

7.3.2 Data Sheet Review

7.3.2.1 VERIFY any Work Orders have been satisfactorily completed and PERs have had the corrective actions completed or closed.

7.3.2.2 VERIFY that all applicable Attachments are complete for the snubber being examined.

7.3.2.3 VERIFY failure analysis of inoperable snubber(s) has been completed, as required.

7.3.2.4 VERIFY the Site Engineering Civil evaluation for the supported system/component analysis, from the appropriate functional test procedure for inoperable snubber(s), has been completed and is acceptable.

7.3.2.5 VERIFY that the evaluation of loose or missing attachment fasteners, has been completed, if required.

7.3.2.6 VERIFY the Snubber Engineer/SE Designee has reviewed all of the appropriate Attachments 2A, 2B, 2C, 3, 4, 5, and 6.

8.0 ILLUSTRATION/ATTACHMENTS

Appendix A,	Snubber Listing.
Attachment 1,	Surveillance Instruction Review Form
Attachment 2A,	Surveillance Visual Examination Checklist For All Snubbers
Attachment 2B,	Surveillance Visual Examination Checklist For Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Snubbers
Attachment 2C,	Surveillance Visual Examination Checklist For Lisega Torus Dynamic Restraint Hydraulic Snubbers
Attachment 3,	Evaluation of Loose or Missing Attachment Fasteners
Attachment 4,	Engineering Evaluation of Unacceptable Indication
Attachment 5,	Engineering Evaluation of Transient Event Indication and Effect
Attachment 6,	BERGEN-PATERSON Torus Dynamic Restraint Fluid Level Check

END OF TEXT

APPENDIX A
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SNUBBER LISTING

EXAM	SUPPORT #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
1	R-22L	3-47B403-8	3-SNUB-075-5009	PSA 35	TORUS ROOM ELEV. 525 AZ 22		L	Y
2	R-22U	3-47B403-8	3-SNUB-075-5010	PSA 35	TORUS ROOM ELEV. 525 AZ 22		N	N
3	R-19	3-47B403-1	3-SNUB-075-5005	PSA 35	TORUS ROOM ELEV. 525 AZ 45		N	N
4	R-20	3-47B403-4	3-SNUB-075-5006	PSA 35	TORUS ROOM ELEV. 525 AZ 112		N	N
5	R-25U	3-47B403-9	3-SNUB-075-5015	PSA 35	TORUS ROOM ELEV. 525 AZ 135		L	Y
6	R-25L	3-47B403-9	3-SNUB-075-5016	PSA 35	TORUS ROOM ELEV. 525 AZ 135		N	N
7	R-23U	3-47B403-5	3-SNUB-075-5011	PSA 35	TORUS ROOM ELEV. 525 AZ 225		L	Y
8	R-23L	3-47B403-5	3-SNUB-075-5012	PSA 35	TORUS ROOM ELEV. 525 AZ 225		N	N
9	R-17	3-47B403-2	3-SNUB-075-5003	PSA 35	TORUS ROOM ELEV. 525 AZ 247		N	N
10	R-24U	3-47B403-7	3-SNUB-075-5013	PSA 35	TORUS ROOM ELEV. 525 AZ 292		L	Y
11	R-24L	3-47B403-7	3-SNUB-075-5014	PSA 35	TORUS ROOM ELEV. 525 AZ 292		N	N
12	R-18	3-47B403-3	3-SNUB-075-5004	PSA 35	TORUS ROOM ELEV. 525 AZ 315		N	N
13	R-21U	3-47B403-6	3-SNUB-075-5008	PSA 35	TORUS ROOM ELEV. 525 AZ 337		L	Y
14	R-21L	3-47B403-6	3-SNUB-075-5007	PSA 35	TORUS ROOM ELEV. 525 AZ 337		N	N
15	TORUS R1	3-48W1266-1	3-SNUB-064-0001	B-P 12	TORUS ROOM ELEV. 528 AZ 11		L	Y
16	TORUS R2	3-48W1266-1	3-SNUB-064-0002	LISEGA 312150	TORUS ROOM ELEV. 528 AZ 34		L	Y
17	TORUS R3	3-48W1266-1	3-SNUB-064-0003	B-P 12	TORUS ROOM ELEV. 528 AZ 56		L	Y
18	TORUS R4	3-48W1266-1	3-SNUB-064-0004	B-P 12	TORUS ROOM ELEV. 528 AZ 79		L	Y
19	TORUS R5	3-48W1266-1	3-SNUB-064-0005	B-P 12	TORUS ROOM ELEV. 528 AZ 101		L	Y
20	TORUS R6	3-48W1266-1	3-SNUB-064-0006	B-P 12	TORUS ROOM ELEV. 528 AZ 124		L	Y
21	TORUS R7	3-48W1266-1	3-SNUB-064-0007	B-P 12	TORUS ROOM ELEV. 528 AZ 146		L	Y
22	TORUS R8	3-48W1266-1	3-SNUB-064-0008	LISEGA 312150	TORUS ROOM ELEV. 528 AZ 169		L	Y
23	TORUS R9	3-48W1266-1	3-SNUB-064-0009	LISEGA 312150	TORUS ROOM ELEV. 528 AZ 191		L	Y
24	TORUS R10	3-48W1266-1	3-SNUB-064-0010	B-P 12	TORUS ROOM ELEV. 528 AZ 213		L	Y
25	TORUS R11	3-48W1266-1	3-SNUB-064-0011	B-P 12	TORUS ROOM ELEV. 528 AZ 236		L	Y
26	TORUS R12	3-48W1266-1	3-SNUB-064-0012	B-P 12	TORUS ROOM ELEV. 528 AZ 259		L	Y
27	TORUS R13	3-48W1266-1	3-SNUB-064-0013	B-P 12	TORUS ROOM ELEV. 528 AZ 281		L	Y
28	TORUS R 14	3-48W1266-1	3-SNUB-064-0014	B-P 12	TORUS ROOM ELEV. 528 AZ 304		L	Y
29	TORUS R 15	3-48W1266-1	3-SNUB-064-0015	B-P 12	TORUS ROOM ELEV. 528 AZ 327		L	Y
30	TORUS R 16	3-48W1266-1	3-SNUB-064-0016	LISEGA 312150	TORUS ROOM ELEV. 528 AZ 348		L	Y
31	R-4N	3-47B456-97	3-SNUB-071-5010	ADH 3	NW Quad : Pump Suction Line EL 528	3-CHM-2412	L	Y
32	R-4S	3-47B456-97	3-SNUB-071-5011	HSSA 3	NW Quad : Pump Suction Line EL 528	3-CHM-2412	L	Y
33	R-22U	3-47B456-57	3-SNUB-071-5001	PSA 1/2	RCIC ROOM ELEV. 528	3-CHM-2412		
34	R-22L	3-47B456-57	3-SNUB-071-5002	PSA 1/2	RCIC ROOM ELEV. 528	3-CHM-2412		
35	3-47B456-49	3-47B456-49	3-SNUB-071-5007	PSA 3	RCIC Missile Shield Roof EL 534	3-CHM-2412	N	N

APPENDIX A
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SNUBBER LISTING

EXAM	SUPPORTNUBBER #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
36	RCIC R-5 E	1806-4	3-SNUB-071-5012	ADH 3	NW Quad: Turbine Discharge EL 538			
37	RCIC R-5 S	1806-4	3-SNUB-071-5013	HSSA 3	NW Quad: Turbine Discharge EL 538			
38	3-47B456-48 N	3-47B456-48	3-SNUB-071-5005	PSA 35	RCIC ROOM EL. 538	3-CHM-2412		Y
39	3-47B456-48 S	3-47B456-48	3-SNUB-071-5006	PSA 35	RCIC ROOM EL. 538	3-CHM-2412		Y
40	R-6 N	3-47B458-94	3-SNUB-075-5017	HSSA 10	NW QUAD ELEV. 544			Y
41	R-6 S	3-47B458-94	3-SNUB-075-5018	HSSA 10	NW QUAD ELEV. 544			Y
42	3-47B458-161 N	3-47B458-161	3-SNUB-075-5001	PSA 10	CS B&D PUMP ROOM ELEV. 538			Y
43	3-47B458-161 S	3-47B458-161	3-SNUB-075-5002	PSA 10	CS B&D PUMP ROOM ELEV. 538			Y
44	3-47B458-96 N	3-47B458-96	3-SNUB-075-5019	HSSA 10	NE QUAD ELEV. 544			Y
45	3-47B458-96 S	3-47B458-96	3-SNUB-075-5020	HSSA 10	NE QUAD ELEV. 544			Y
46	R-78U	3-47B455-78	3-SNUB-073-5006	PSA 3	RHR PUMP ROOM B&D ELEV. 523	3-CHM-2413 (3 OF 3)	N	Y
47	R-78L	3-47B455-78	3-SNUB-073-5007	PSA 3	RHR PUMP ROOM B&D ELEV. 523	3-CHM-2413 (3 OF 3)	N	N
51	R-79	3-47B455-41	3-SNUB-073-5008	PSA 3	HPCI ROOM : SE QUAD EL. 537			
52	R-53	3-47B455-54	3-SNUB-073-5003	PSA 35	HPCI ROOM : SE QUAD EL. 538	3-CHM-2413 (2 OF 3)		Y
53	R-52U	3-47B455-55	3-SNUB-073-5001	PSA 35	HPCI ROOM : SE QUAD EL. 538	3-CHM-2413 (2 OF 3)		Y
54	R-52L	3-47B455-55	3-SNUB-073-5002	PSA 35	HPCI ROOM : SE QUAD EL. 538	3-CHM-2413 (2 OF 3)		Y
55	H-182	3-47B455-50	3-SNUB-073-5014	PSA 1/2	RHR PUMP ROOM B&D ELEV. 538		Y	Y
60	3-47B452-1446	3-47B452-1446	3-SNUB-074-5042	PSA 3	SW QUAD PUMP ROOM A & C ELEV.536	3-ISI-0395 (9 OF 17)		
67	R-81	3-47B452-122	3-SNUB-074-5009	PSA 35	SIDE OF TORUS ELEV. 555 AZ 30	3-ISI-0395 (10 OF 17)		
68	R-83	3-47B455-746	3-SNUB-073-5009	PSA 10	SE QUAD ELEV. 523 AZ 45	3-CHM-2413 (3 OF 3)	N	N
69	3-47B452-1544	3-47B452-1544	3-SNUB-074-5037	HSSA 20	SIDE OF TORUS BAY 3 AZ 55	3-ISI-0395 (10 OF 17)		Y
70	3-47B452-1557	3-47B452-1557	3-SNUB-074-5038	ADH 30	SIDE OF TORUS BAY 3 AZ 55	3-ISI-0395 (10 OF 17)		Y
71	R-41 IN	3-47B452-129	3-SNUB-074-5040	HSSA 3	TOP OF TORUS BAY 3 AZ 55	3-ISI-0395 (12 OF 17)	N	N
72	R-41 OUT	3-47B452-129	3-SNUB-074-5039	HSSA 3	TOP OF TORUS BAY 3 AZ 55	3-ISI-0395 (12 OF 17)	N	N
73	R80	3-47B452-112	3-SNUB-074-5008	PSA 10	TOP OF TORUS BAY 3 AZ 65	3-ISI-0395 (10 OF 17)	N	N
74	R-93 E	3-47B452-108	3-SNUB-074-5020	PSA 1	TOP OF TORUS BAY 4 AZ 75		N	
75	R-93 W	3-47B452-108	3-SNUB-074-5021	PSA 1	TOP OF TORUS BAY 4 AZ 75		N	
76	R-92 E	3-47B452-104	3-SNUB-074-5018	PSA 10	TOP OF TORUS BAY 5 AZ 85		N	
77	R-92 W	3-47B452-104	3-SNUB-074-5019	PSA 10	TOP OF TORUS BAY 5 AZ 85		N	
78	R-91	3-47B452-95	3-SNUB-074-5017	PSA 3	TOP OF TORUS BAY 5 AZ 85		N	
79	R-88 N	3-47B452-110	3-SNUB-074-5013	PSA 35	TOP OF TORUS BAY 5 AZ 90		N	Y
80	R-88 S	3-47B452-110	3-SNUB-074-5014	PSA 35	TOP OF TORUS BAY 5 AZ 90		N	
81	R39	3-47B452-619	3-SNUB-071-5008	PSA 3	TOP OF TORUS BAY 5 AZ 90		N	
82	R-42	3-47B452-65	3-SNUB-071-5009	PSA 1	TOP OF TORUS BAY 5 AZ 90		N	
83	R-19	3-47B452-100	3-SNUB-074-5036	HSSA 10	TOP OF TORUS BAY 5 AZ 90	3-ISI-0395 (10 OF 17)	N	

APPENDIX A
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SNUBBER LISTING

EXAM	SUPPORTNUBBER #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
84	H-61A	3-47B456-712	3-SNUB-071-5003	PSA 1/2	SIDE OF TORUS ELEV. 545 AZ 95			
89	RCIC R 7 U	3-47B456-718	3-SNUB-071-5014	HSSA 3	SIDE OF TORUS BAY 8 ELEV. 548 AZ 157			
90	RCIC R 7 L	3-47B456-718	3-SNUB-071-5015	HSSA 3	SIDE OF TORUS BAY 8 ELEV. 548 AZ 157			
97	R-87 N	3-47B452-109	3-SNUB-074-5011	PSA 35	SIDE OF TORUS BAY 13 ELEV. 549 AZ 270			
98	R-87 S	3-47B452-109	3-SNUB-074-5012	PSA 35	SIDE OF TORUS BAY 13 ELEV. 549 AZ 270			
99	R-66	3-47B455-737	3-SNUB-073-5005	PSA 1	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		N	
100	R-95 E	3-47B452-124	3-SNUB-074-5001	PSA 1/4	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		N	
101	R-95 W	3-47B452-124	3-SNUB-074-5002	PSA 1/4	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		N	
102	R-90 E	3-47B452-114	3-SNUB-074-5015	PSA 10	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		N	
103	R-90 W	3-47B452-114	3-SNUB-074-5016	PSA 10	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		Y	Y
104	R-105	3-47B452-106	3-SNUB-074-5028	PSA 3	TOP OF TORUS BAY 13 ELEV. 554 AZ 270		N	
106	R-99	3-47B452-121	3-SNUB-074-5025	PSA 10	TOP OF TORUS BAY 14 ELEV. 554 AZ 285	3-ISI-0395 (11 OF 17)	N	
107	R-55	3-47B455-39	3-SNUB-073-5004	PSA 3	TOP OF TORUS BAY 14 ELEV. 538 AZ 294		N	
108	3-47B455-629	3-47B455-629	3-SNUB-073-5010	PSA 10	TOP OF TORUS BAY 14 ELEV. 543 AZ 300	3-CHM-2413 (2 OF 3)	Y	Y
110	3-47B452-1494	3-47B452-1494	3-SNUB-074-5034	HSSA 30	TOP OF TORUS BAY 15 ELEV. 550 AZ 300	3-ISI-0395 (11 OF 17)	N	N
111	3-47B452-1491	3-47B452-1491	3-SNUB-074-5035	HSSA 30	TOP OF TORUS BAY 15 ELEV. 550 AZ 300	3-ISI-0395 (11 OF 17)	N	Y
112	3-47B452-1492	3-47B452-1492	3-SNUB-074-5010	PSA 10	SIDE OF TORUS BAY 15 AZ 320	3-ISI-0395 (11 OF 17)	N	N
113	RCIC R 9 S	3-47B456-719	3-SNUB-071-5017	ADH 3	STEAM TUNNEL ELEV. 564		N	N
114	RCIC R 9 N	3-47B456-719	3-SNUB-071-5016	ADH 3	STEAM TUNNEL ELEV. 564		N	N
115	R-159	3-47B452-134	3-SNUB-074-5031	PSA 10	FLOOR ELEV. 565 ELEV. 579 AZ 43	3-ISI-0395 (12 OF 17)	L	Y
116	R-58	3-47B452-133	3-SNUB-074-5004	PSA 10	FLOOR ELEV. 565 ELEV. 579 AZ 43	3-ISI-0395 (12 OF 17)	L	Y
134	3-47B451R0024	3-47B451R0024	3-SNUB-067-5001	PSA 10	Core Spray Platform(on grating) ELEV. 606		N	N
135	3-47B451R0020	3-47B451R0020	3-SNUB-067-5002	PSA 10	NEAR COLUMN R 20 & P LINE EL. 606		N	N
136	R-158 N	3-47B452-130	3-SNUB-074-5056	HSSA 3	NEAR COLUMN R 19 & S LINE ELEV. 598	3-ISI-0395 (13 OF 17)	N	N
137	R-158 S	3-47B452-130	3-SNUB-074-5057	HSSA 3	NEAR COLUMN R 19 & S LINE ELEV. 598	3-ISI-0395 (13 OF 17)	N	N
138	3-47B451R0017	3-7B451R0017	3-SNUB-067-5003	PSA 10	R-20 AND U-LINE ELEV. 608		L	Y
139	R-62	3-47B452-126	3-SNUB-074-5007	PSA 35	FLOOR ELEV. 593 ELEV. 598 AZ 315	3-ISI-0395 (13 OF 17)	N	N
140	R-61	3-47B452-691	3-SNUB-074-5005	PSA 3	Floor El. 593 El. 598, W of R 19 & So. of S		N	N
141	R-61	3-47B452-691	3-SNUB-074-5006	PSA 3	FLOOR ELEV. 593 ELEV. 598 AZ 45		N	N
142	3-47B452-1561	3-47B452-1561	3-SNUB-074-5003	PSA 1/2	FLOOR ELEV. 593 ELEV. 601 AZ 45			
143	3-47B462-27	3-47B462-27	3-SNUB-063-5001	HSSA 3	FLOOR ELEV. 621 ELEV. 624 AZ 210		N	N
144	R-94 E	3-47B452-96	3-SNUB-074-5023	PSA 35	DRYWELL ELEV. 565 AZ 30 (CLEAN RM)	3-ISI-0395 (10 OF 17)	N	N
145	R-94 N	3-47B452-96	3-SNUB-074-5022	PSA 100	DRYWELL ELEV 565 AZ 30 (CLEAN RM)	3-ISI-0395 (10 OF 17)	N	N
146	R-102 N	3-47B452-97	3-SNUB-074-5026	PSA 35	DRYWELL ELEV 565 AZ 300 (CLEAN RM)	3-ISI-0395 (11 OF 17)	N	N
147	R-102 W	3-47B452-97	3-SNUB-074-5027	PSA 10	DRYWELL ELEV 565 AZ 300 (CLEAN RM)	3-ISI-0395 (11 OF 17)	N	N

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SNUBBER LISTING

EXAM	SUPPORTNUBBER #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
148	3-47B465-498	3-47B465-498	3-SNUB-068-5004	PSA 35	DRYWELL BASEMENT ELEV. 556 AZ 122	3-ISI-0337 (2 OF 2)	L	Y
149	3-47B465-497	3-47B465-497	3-SNUB-068-5002	PSA 35	DRYWELL BASEMENT ELEV. 552 AZ 135	3-ISI-0337 (2 OF 2)	N	N
150	3-47B465-499	3-47B465-499	3-SNUB-068-5016	PSA 35	DRYWELL BASEMENT ELEV. 556 AZ 148	3-ISI-0337 (2 OF 2)	L	Y
151	3-47B465-474	3-47B465-474	3-SNUB-068-5017	PSA 10	DRYWELL BASEMENT ELEV. 552 AZ 171	3-ISI-0337 (2 OF 2)	N	N
152	3-47B465-513	3-47B465-513	3-SNUB-068-5001	PSA 35	DRYWELL BASEMENT ELEV. 552 AZ 302	3-ISI-0337 (1 OF 2)	N	N
153	3-47B465-514	3-47B465-514	3-SNUB-068-5003	PSA 35	DRYWELL BASEMENT ELEV. 552 AZ 315	3-ISI-0337 (1 OF 2)	N	Y
154	3-47B465-515	3-47B465-515	3-SNUB-068-5015	PSA 35	DRYWELL BASEMENT ELEV. 556 AZ 320	3-ISI-0337 (1 OF 2)	N	Y
155	3-47B465-454	3-47B465-454	3-SNUB-068-5018	PSA 35	DRYWELL BASEMENT ELEV. 556 AZ 350	3-ISI-0337 (1 OF 2)	N	Y
156	3-47B452-3041	3-47B452-3041	3-SNUB-074-5063	PSA 35	DRYWELL GRATING ELEV. 579 AZ 5	3-ISI-0340 (1 OF 1)	L	Y
157	3-47B455-622	3-47B455-622	3-SNUB-073-5012	PSA 3	DRYWELL GRATING ELEV. 563 AZ 25	3-ISI-335 (1 OF 1)	N	N
158	3-47B452-3040	3-47B452-3040	3-SNUB-074-5062	PSA 10	DRYWELL GRATING ELEV. 577 AZ 25	3-ISI-0340 (1 OF 1)	L	Y
160	3-47B465-508	3-47B465-508	3-SNUB-068-5014	PSA 35	DRYWELL GRATING ELEV. 583 AZ 98	3-ISI-0337 (2 OF 2)	Y	Y
161	MSS-17	3-47B401-56	3-SNUB-001-5052	PSA 3	DRYWELL GRATING ELEV. 564 AZ 100	3-ISI-0453 (2 OF 9)	L	Y
162	MSS-16	3-47B401-57	3-SNUB-001-5051	PSA 10	DRYWELL GRATING ELEV. 564 AZ 100	3-ISI-0453 (2 OF 9)	L	Y
163	3-47B465-503	3-47B465-503	3-SNUB-068-5007	PSA 35	DRYWELL GRATING ELEV. 566 AZ 115	3-ISI-0337 (2 OF 2)	N	Y
164	3-47B465-504	3-47B465-504	3-SNUB-068-5010	PSA 35	DRYWELL GRATING ELEV. 573 AZ 135	3-ISI-0337 (2 OF 2)	L	Y
165	3-47B465-505	3-47B465-505	3-SNUB-068-5008	PSA 35	DRYWELL GRATING ELEV. 566 AZ 154	3-ISI-0337 (2 OF 2)	N	N
166	MSS 19 N	3-47B401-62	3-SNUB-001-5055	PSA 10	DRYWELL GRATING ELEV. 575 AZ 225	3-ISI-453 (8 OF 9)	L	Y
167	MSS 19 S	3-47B401-62	3-SNUB-001-5056	PSA 10	DRYWELL GRATING ELEV. 575 AZ 225	3-ISI-453 (8 OF 9)	L	Y
168	RSSL- 4	3-47B401-51	3-SNUB-001-5044	PSA 10	DRYWELL GRATING ELEV. 583 AZ 225	3-ISI-453 (8 OF 9)	Y	Y
169	RSSL -3	3-47B401-52	3-SNUB-001-5043	PSA 10	DRYWELL GRATING ELEV. 583 AZ 225	3-ISI-453 (8 OF 9)	Y	Y
170	RSSJ -3	3-47B401-40	3-SNUB-001-5035	PSA 10	DRYWELL GRATING ELEV. 583 AZ 225	3-ISI-453 (8 OF 9)	Y	Y
171	RSSJ -4	3-47B401-41	3-SNUB-001-5034	PSA 10	DRYWELL GRATING ELEV. 583 AZ 225	3-ISI-453 (8 OF 9)	Y	Y
172	3-47B465-511	3-47B465-511	3-SNUB-068-5011	PSA 35	DRYWELL GRATING ELEV. 583 AZ 262	3-ISI-0337 (1 OF 2)	Y	Y
173	3-47B465-519	3-47B465-519	3-SNUB-068-5005	PSA 35	DRYWELL GRATING ELEV. 566 AZ 295	3-ISI-0337 (1 OF 2)	L	Y
174	3-47B465-520	3-47B465-520	3-SNUB-068-5009	PSA 35	DRYWELL GRATING ELEV. 573 AZ 315	3-ISI-0337 (1 OF 2)	L	Y
176	RSSG -3	3-47B401-30	3-SNUB-001-5022	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
177	RSSG -4	3-47B401-30	3-SNUB-001-5023	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
179	RSSG -6	3-47B401-31	3-SNUB-001-5025	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	L	Y
180	RSSH -3	3-47B401-35	3-SNUB-001-5028	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
181	RSSH -4	3-47B401-35	3-SNUB-001-5029	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
182	RSSH -5	3-47B401-36	3-SNUB-001-5030	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	L	Y
184	RSSK -3	3-47B401-46	3-SNUB-001-5039	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
185	RSSK -4	3-47B401-46	3-SNUB-001-5040	PSA 10	DRYWELL GRATING ELEV. 583 AZ 330	3-ISI-453 (4 OF 9)	Y	Y
186	3-47B465-521	3-47B465-521	3-SNUB-068-5006	PSA 35	DRYWELL GRATING ELEV. 566 AZ 335	3-ISI-0337 (1 OF 2)	N	Y

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EXAM	SUPPORT #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
187	3-47B452-3032	3-47B452-3032	3-SNUB-074-5064	PSA 35	DRYWELL GRATING ELEV. 577 AZ 335	3-ISI-0340 (1 OF 1)	L	Y
189	3-47B400-119	3-47B400-119	3-SNUB-001-5061	PSA 35	DRYWELL STEAM DECK ELEV. 585 AZ 20	3-ISI-0338 (2 OF 2)	N	N
190	RSSC-2	3-47B401-11	3-SNUB-001-5008	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 30	3-ISI-0453 (2 OF 9)	N	N
191	RSSC-1	3-47B401-11	3-SNUB-001-5007	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 35	3-ISI-0453 (2 OF 9)	N	N
192	3-47B400-121	3-47B400-121	3-SNUB-001-5063	HSSA 20	DRYWELL STEAM DECK ELEV. 585 AZ 35	3-ISI-0338 (2 OF 2)	N	N
193	RSSC-3	3-47B401-13	3-SNUB-001-5009	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 40	3-ISI-0453 (2 OF 9)	N	N
194	3-47B400-118	3-47B400-118	3-SNUB-001-5062	PSA 35	DRYWELL STEAM DECK ELEV. 585 AZ 40	3-ISI-0338 (2 OF 2)	Y	Y
195	RSSC-4	3-47B401-13	3-SNUB-001-5010	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 45	3-ISI-0453 (2 OF 9)	N	N
196	RSSD-1	3-47B401-15	3-SNUB-001-5011	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 45	3-ISI-0453 (2 OF 9)	N	N
197	RSSD-2	3-47B401-15	3-SNUB-001-5012	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 50	3-ISI-0453 (2 OF 9)	N	N
198	3-47B415-21	3-47B415-21	3-SNUB-003-5017	HSSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 50	3-ISI-0336 (1 OF 1)	N	N
199	RSSD-3	3-47B401-17	3-SNUB-001-5013	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 55	3-ISI-0453 (2 OF 9)	N	N
200	RSSD-4	3-47B401-17	3-SNUB-001-5014	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 55	3-ISI-0453 (2 OF 9)	N	N
201	3-47B415-22	3-47B415-22	3-SNUB-003-5018	HSSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 55	3-ISI-0336 (1 OF 1)	N	N
202	3-47B415-27	3-47B415-27	3-SNUB-003-5022	PSA 35	DRYWELL STEAM DECK ELEV.585 AZ130	3-ISI-0336 (1 OF 1)	Y	Y
203	RSSA-1	3-47B401-3	3-SNUB-001-5001	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 60	3-ISI-0453 (2 OF 9)	N	N
204	RSSA-2	3-47B401-3	3-SNUB-001-5002	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 65	3-ISI-0453 (2 OF 9)	N	N
205	RSSA-3	3-47B401-4	3-SNUB-001-5003	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 70	3-ISI-0453 (2 OF 9)	N	N
206	RSSA-4	3-47B401-5	3-SNUB-001-5004	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 70	3-ISI-0453 (2 OF 9)	N	N
209	3-47B400-115	3-47B400-115	3-SNUB-001-5059	HSSA-30	DRYWELL STEAM DECK ELEV. 585 AZ 90	3-ISI-0338 (2 OF 2)	N	N
210	3-47B415-25	3-47B415-25	3-SNUB-003-5021	PSA 10	DRYWELL STEAM DECK ELEV. 585 AZ 90	3-ISI-0336 (1 OF 1)	N	N
211	3-47B400-89	3-47B400-89	3-SNUB-001-5058	HSSA 20	DRYWELL STEAM DECK ELEV. 585 AZ 91	3-ISI-0338 (1 OF 2)	N	
212	MSS 15 S	3-47B401-54	3-SNUB-001-5050	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ100	3-ISI-0453 (2 OF 9)	N	N
213	MSS 15 N	3-47B401-54	3-SNUB-001-5049	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ100	3-ISI-0453 (2 OF 9)	N	N
214	3-47B400-88	3-47B400-88	3-SNUB-001-5057	HSSA 20	DRYWELL STEAM DECK ELEV.585 AZ105	3-ISI-0338 (1 OF 2)	N	
215	3-47B400-116	3-47B400-116	3-SNUB-001-5060	PSA 35	DRYWELL STEAM DECK ELEV.585 AZ115	3-ISI-0338 (2 OF 2)	N	N
216	3-47B415-26	3-47B415-26	3-SNUB-003-5023	PSA 35	DRYWELL STEAM DECK ELEV.585 AZ130	3-ISI-0336 (1 OF 1)	N	N
217	RSSE -4	3-47B401-19	3-SNUB-001-5017	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ135	3-ISI-0453 (6 OF 9)	N	N
218	RSSB-1	3-47B401-8	3-SNUB-001-5005	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ140	3-ISI-0453 (6 OF 9)	N	Y
219	RSSB-2	3-47B401-8	3-SNUB-001-5006	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ140	3-ISI-0453 (6 OF 9)	N	Y
220	RSSF-1	3-47B401-24	3-SNUB-001-5018	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ145	3-ISI-0453 (6 OF 9)	N	Y
221	RSSF-2	3-47B401-24	3-SNUB-001-5019	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ145	3-ISI-0453 (6 OF 9)	N	Y
222	RSSE -3	3-47B401-21	3-SNUB-001-5016	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ150	3-ISI-0453 (6 OF 9)	N	N
223	RSSE -2	3-47B401-21	3-SNUB-001-5015	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ150	3-ISI-0453 (6 OF 9)	N	N
224	3-47B415-56	3-47B415-56	3-SNUB-003-5031	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ215	3-ISI-336 (1 OF 1)	N	N

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EXAM	SUPPORT #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
225	RSSL-2	3-47B401-49	3-SNUB-001-5042	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ225	3-ISI-0453 (8 OF 9)	N	N
226	RSSL-1	3-47B401-49	3-SNUB-001-5041	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ225	3-ISI-0453 (8 OF 9)	N	N
227	3-47B415-57	3-47B415-57	3-SNUB-003-5032	PSA 35	DRYWELL STEAM DECK ELEV.585 AZ230	3-ISI-0336 (1 OF 1)	Y	Y
228	RSSJ-1	3-47B401-38	3-SNUB-001-5032	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ230	3-ISI-0453 (8 OF 9)	N	N
229	RSSJ-2	3-47B401-38	3-SNUB-001-5033	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ230	3-ISI-0453 (8 OF 9)	N	N
230	3-47B400-101	3-47B400-101	3-SNUB-001-5064	HSSA 30	DRYWELL STEAM DECK ELEV.585 AZ240	3-ISI-0338 (2 OF 2)	N	N
231	3-47B400-74	3-47B400-74	3-SNUB-001-5069	PSA 35	DRYWELL STEAM DECK ELEV.585 AZ250	3-ISI-0338 (1 OF 2)	N	Y
232	MSS 18 N	3-47B401-59	3-SNUB-001-5053	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ225	3-ISI-0453 (8 OF 9)	N	N
233	MSS 18 S	3-47B401-59	3-SNUB-001-5054	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ225	3-ISI-0453 (8 OF 9)	N	N
234	3-47B415-55	3-47B415-55	3-SNUB-003-5028	HSSA 10	DRYWELL STEAM DECK ELEV.601 AZ260	3-ISI-0336 (1 OF 1)	Y	Y
235	3-47B400-102	3-47B400-102	3-SNUB-001-5065	ADH 30	DRYWELL STEAM DECK ELEV.585 AZ262	3-ISI-0338 (2 OF 2)	N	N
236	3-47B400-75	3-47B400-75	3-SNUB-001-5070	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ270	3-ISI-0338 (1 OF 2)	N	N
237	3-47B415-48	3-47B415-48	3-SNUB-003-5030	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ270	3-ISI-0336 (1 OF 1)	N	N
238	3-47B400-77	3-47B400-77	3-SNUB-001-5048	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ280	3-ISI-0338 (1 OF 2)	N	N
239	3-47B400-77	3-47B400-77	3-SNUB-001-5047	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ280	3-ISI-0338 (1 OF 2)	N	N
240	3-47B415-53	3-47B415-53	3-SNUB-003-5026	HSSA 10	DRYWELL STEAM DECK ELEV.585 AZ295	3-ISI-0336 (1 OF 1)	N	N
241	3-47B415-54	3-47B415-54	3-SNUB-003-5027	HSSA 10	DRYWELL STEAM DECK ELEV.585 AZ305	3-ISI-0336 (1 OF 1)	N	N
242	RSSK-1	3-47B401-43	3-SNUB-001-5036	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ315	3-ISI-0453 (4 OF 9)	N	N
243	3-47B400-103	3-47B400-103	3-SNUB-001-5066	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ315	3-ISI-0338 (2 OF 2)	N	N
244	3-47B415-52	3-47B415-52	3-SNUB-003-5024	HSSA 10	DRYWELL STEAM DECK ELEV.585 AZ320	3-ISI-0336 (1 OF 1)	Y	Y
245	3-47B400-104	3-47B400-104	3-SNUB-001-5067	HSSA 10	DRYWELL STEAM DECK ELEV.585 AZ320	3-ISI-0338 (2 OF 2)	Y	Y
246	3-47B400-105	3-47B400-105	3-SNUB-001-5068	HSSA 20	DRYWELL STEAM DECK ELEV.585 AZ320	3-ISI-0338 (2 OF 2)	N	N
247	RSSK-2	3-47B401-44	3-SNUB-001-5037	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ322	3-ISI-0453 (4OF 9)	N	N
248	RSSK -3	3-47B401-44	3-SNUB-001-5038	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ322	3-ISI-0453 (4OF 9)	N	N
249	RSSG-1	3-47B401-29	3-SNUB-001-5020	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ330	3-ISI-0453 (4OF 9)	N	N
250	RSSG-2	3-47B401-28	3-SNUB-001-5021	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ335	3-ISI-0453 (4OF 9)	N	N
251	RSSH-1	3-47B401-34	3-SNUB-001-5026	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ335	3-ISI-0453 (4OF 9)	N	N
252	RSSH-2	3-47B401-33	3-SNUB-001-5027	PSA 10	DRYWELL STEAM DECK ELEV.585 AZ335	3-ISI-0453 (4OF 9)	N	N
253	3-47B415-59	3-47B415-59	3-SNUB-003-5025	HSSA 10	DRYWELL STEAM DECK ELEV.585 AZ340	3-ISI-0336 (1 OF 1)	Y	Y
254	3-47B415-20	3-47B415-20	3-SNUB-003-5016	HSSA 10	DRYWELL STEAM DECK ELEV. 601 AZ 25	3-ISI-0336 (1 OF 1)	Y	Y
255	3-47B415-19	3-47B415-19	3-SNUB-003-5015	HSSA 10	DRYWELL STEAM DECK ELEV. 601 AZ 35	3-ISI-0336 (1 OF 1)	Y	Y
263	3-47B415-24	3-47B415-24	3-SNUB-003-5020	HSSA 10	DRYWELL STEAM DECK ELEV. 601 AZ 80	3-ISI-0336 (1 OF 1)	Y	Y
264	3-47B415-23	3-47B415-23	3-SNUB-003-5019	HSSA 10	DRYWELL STEAM DECK ELEV.601 AZ100	3-ISI-0336 (1 OF 1)	Y	Y
267	3-47B415-64	3-47B415-64	3-SNUB-003-5029	HSSA 10	DRYWELL STEAM DECK ELEV.601 AZ220	3-ISI-0336 (1 OF 1)	N	N
265	3-47B458-558	3-47B458-558	3-SNUB-075-5024	HSSA 10	DRYWELL STEAM DECK ELEV.608 AZ135	3-ISI-0339 (1 OF 1)	N	N

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EXAM	SUPPORT #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
266	3-47B458-559	3-47B458-559	3-SNUB-075-5023	HSSA 10	DRYWELL STEAM DECK ELEV.608 AZ215	3-ISI-0339 (1 OF 1)	Y	Y
268	3-47B458-566	3-47B458-566	3-SNUB-075-5022	HSSA 10	DRYWELL STEAM DECK ELEV.608 AZ220	3-ISI-0339 (1 OF 1)	N	N
269	3-47B458-567	3-47B458-567	3-SNUB-075-5021	HSSA 10	DRYWELL STEAM DECK ELEV.608 AZ230	3-ISI-0339 (1 OF 1)	N	N
278	R-10	3-47B452-105	3-SNUB-074-5065	HSSA 20	TOP OF TORUS BAY 13 ELEV. 557 AZ 270	3-ISI-0395 (11 OF 17)	N	N
279	3-47B600-1634	3-47B600-1634	3-SNUB-003-5036	PSA 1	DRYWELL STEAM DECK ELEV. 631 AZ 37			
280	3-47B600-1636	3-47B600-1636	3-SNUB-003-5037	PSA 1	DRYWELL STEAM DECK ELEV. 631 AZ 37			
281	3-47B600-1637	3-47B600-1637	3-SNUB-003-5038	PSA 1	DRYWELL STEAM DECK ELEV.631 AZ220			
282	3-47B600-1638	3-47B600-1638	3-SNUB-003-5039	PSA 1	DRYWELL STEAM DECK ELEV.631 AZ220			
283	3-47B406-219	3-47B406-219	3-SNUB-069-5003	PSA 3	STEM TUNN CLEAN UP EL. 587 AZ 220		Y	Y
284	3-47B406-270	3-47B406-270	3-SNUB-069-5002	PSA 3	STEAM TUNNEL ELEV.587			
285	3-47B406-291	3-47B406-291	3-SNUB-069-5005	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ351	3-ISI-0334 (1 OF 1)	N	N
286	3-47B406-288	3-47B406-288	3-SNUB-069-5004	PSA 3	DRYWELL STEAM DECK ELEV.585 AZ351	3-ISI-0334 (1 OF 1)	N	N
287	3-47B406-289	3-47B406-289	3-SNUB-069-5006	PSA 3	DRYWELL STEAM DECK ELEV.598 AZ345	3-ISI-0334 (1 OF 1)	Y	Y
288	3-47B465-546	3-47B465-546	3-SNUB-068-5019	PSA 35	DRYWELL GRATING ELEV. 583 AZ 75	3-ISI-0337 (2 OF 2)	N	N
289	3-47B465-484	3-47B465-484	3-SNUB-068-5020	PSA 35	DRYWELL GRATING ELEV. 583 AZ 98	3-ISI-0337 (2 OF 2)	N	Y
290	3-47B400-227	3-47B400-227	3-SNUB-001-5071	PSA 1	DRYWELL GRATING ELEV. 563 AZ 180		N	N
291	3-47B400-228	3-47B400-228	3-SNUB-001-5072	PSA 1	DRYWELL GRATING ELEV. 565 AZ 225			
292	3-47B400-223	3-47B400-223	3-SNUB-001-5073	PSA 1	DRYWELL GRATING ELEV. 566 AZ 225			
293	3-47B400-229	3-47B400-229	3-SNUB-001-5074	PSA 3	DRYWELL GRATING ELEV. 566 AZ 225		N	N
294	3-47B400-107	3-47B400-107	3-SNUB-001-5075	PSA 35	DRYWELL STEAM DECK ELEV.586 AZ203	3-ISI-0338 (2 OF 2)	L	Y
295	3-47B452-3034	3-47B452-3034	3-SNUB-074-5068	PSA 35	DRYWELL GRATING ELEV. 577 AZ 270	3-ISI-0340 (1 OF 1)	Y	Y
296	3-47B465-545	3-47B465-545	3-SNUB-068-5023	PSA 35	DRYWELL GRATING ELEV. 580 AZ 270	3-ISI-0337 (1 OF 2)		
297	3-47B465-524	3-47B465-524	3-SNUB-068-5022	PSA 35	DRYWELL GRATING ELEV. 565 AZ 270			
299	3-47B456-693	3-47B456-693	3-SNUB-071-5018	PSA 1	DRYWELL GRATING ELEV. 579 AZ 232			
300	3-47B465-493	3-47B465-493	3-SNUB-010-5002	PSA 3	DRYWELL STEAM DECK ELEV.628 AZ232		N	N
301	3-47B465-494	3-47B465-494	3-SNUB-010-5001	PSA 3	DRYWELL STEAM DECK ELEV.634 AZ225			
302	3-47B452-3042	3-47B452-3042	3-SNUB-074-5066	PSA 35	DRYWELL GRATING ELEV. 579 AZ 0	3-ISI-0340 (1 OF 1)	L	Y
303	3-47B464-522	3-47B464-522	3-SNUB-070-5014	PSA 1	TOP OF TORUS BAY 11 ELEV. 553 AZ 215			
304	3-47B464-470	3-47B464-470	3-SNUB-070-5015	PSA 1	TOP OF TORUS BAY 11 ELEV. 548 AZ 225		Y	Y
305	3-47B400-92	3-47B400-92	3-SNUB-001-5076	PSA 10	DRYWELL STEAM DECK ELEV.604 AZ 75	3-ISI-0338 (1 OF 2)	N	Y
306	3-47B400-91 U	3-47B400-91	3-SNUB-001-5077	PSA 10	DRYWELL STEAM DECK ELEV.586 AZ 76	3-ISI-0338 (1 OF 2)		
307	3-47B400-91 L	3-47B400-91	3-SNUB-001-5078	PSA 10	DRYWELL STEAM DECK ELEV.586 AZ 76	3-ISI-0338 (1 OF 2)		
308	3-47B400-208	3-47B400-208	3-SNUB-001-5079	PSA 35	DRYWELL STEAM DECK ELEV 586AZ154	3-ISI-0338 (2 OF 2)	N	N
309	3-47B465-512	3-47B465-512	3-SNUB-068-5021	PSA 35	DRYWELL STEAM DECK ELEV 586AZ259	3-ISI-0337 (1 OF 2)	Y	Y

APPENDIX A
(Page 8 of 8)

SNUBBER LISTING

EXAM	SUPPORT #	SNUBBER DRAWING #	UNID #	TYPE/SIZE	LOCATION	ISI DRAWING #	Scaffold Required For Visual	Scaffold Required For Functional Test
310	3-47B415-67	3-47B415-67	3-SNUB-003-5035	PSA 10	DRYWELL STEAM DECK ELEV.586 AZ220	3-ISI-0336 (1 OF 1)	N	N
311	3-47B452-3047	3-47B452-3047	3-SNUB-074-5067	PSA 35	DRYWELL GRATING ELEV 577 AZ 290	3-ISI-0340 (1 OF 1)	L	Y
312	3-47B465-457	3-47B465-457	3-SNUB-068-5024	PSA 10	DRYWELL BASEMENT ELEV 556 AZ 270	3-ISI-0337 (1 OF 2)	L	Y
313	3-47B465-480	3-47B465-480	3-SNUB-068-5025	PSA 10	DRYWELL BASEMENT ELEV 556 AZ 90	3-ISI-0337 (2 OF 2)	N	Y
314	H-81	3-47B458-143	3-SNUB-075-5027	PSA 35	NW QUAD ELEV 538			
315	3-47B455-649	3-47B455-649	3-SNUB-073-5013	PSA 3	HPCI ROOM : S.E. QUAD EL. 541	3-CHM-2413 (2 OF 3)	Y	Y
316	3-47B553-39	3-47B553-39	3-SNUB-002-5018	PSA 3	SIDE OF TORUS BAY 6 ELEV. 548 AZ 105			
317	3-47B553-40	3-47B553-40	3-SNUB-002-5014	PSA 10	SIDE OF TORUS BAY 9 ELEV. 548 AZ 180			
318	3-47B454-677	3-47B454-677	3-SNUB-078-5001	PSA 3	S W QUAD ELEV. 556		Y	Y
319	3-47B553-41	3-47B553-41	3-SNUB-002-5015	PSA 35	SIDE OF TORUS BAY 9 ELEV. 548 AZ 180		Y	Y
320	3-47B553-85	3-47B553-85	3-SNUB-002-5013	PSA 3	SIDE OF TORUS BAY 7 ELEV. 548 AZ 144			
321	3-47B553-35	3-47B553-35	3-SNUB-002-5016	PSA 3	SIDE OF TORUS		Y	Y
322	3-47B553-35	3-47B553-35	3-SNUB-002-5017	PSA 3	SIDE OF TORUS		Y	Y

ATTACHMENT 1

(Page 1 of 1)

SURVEILLANCE INSTRUCTION REVIEW FORM

DATE/TIME STARTED ______________ DATE/TIME COMPLETED ______________

REASON FOR TEST: PLANT MODE 1 2 3 4 5 (Circle appropriate Mode)

_____Scheduled Surveillance

_____System Inoperable (Explain in Remarks)

_____Maintenance

_____Other (Explain in Remarks)

MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING

FLUID TYPE______________ TIIC/STOCK NO.______________ 575N/SIR______________

PRE-TEST REMARKS:____

PERFORMER :

Initials	Name (Print)	Name (Signature)

NOTE:
The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is NOT Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted ____________ Date _____ Time _____

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted ____________ Date _____ Time _____

SECTION REVIEWER (MM) - ______________________________ Date _____

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data were complete and correct; acceptance criteria were met or justification for exceptions provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was fully completed, as applicable, except as noted in Post-Test Remarks.

SNUBBER ENGINEER/
SITE CIVIL ENGINEERING REVIEWER - ______________________________ Date _______

SCHEDULING COORDINATOR - ______________________________ Date _______

POST-TEST REMARKS: ______________________________

FREQ - Ref. Master Sched
FREQ IN RO - N/A
KEY - 390

ATTACHMENT 2A
(Page 1 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR ALL SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. __________ Exam No._____

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size ___________
(Circle type snubber being examined)

PER No.____________________

Attachments 2B, 2C or Attachment 6 shall be attached with Attachment 2A for the appropriate type hydraulic snubber being examined.

1. The snubber has no visible indications of damage or impaired operability. The following attributes will determine the acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
( )	( )	( )	Observe for any signs of over stressing
( )	( )	( )	Observe the exposed parts of the snubber for broken parts, deformation or other damage, such as, weld arc strikes, paint, weld slag, adhesive, or other deposits on piston rod or support cylinder that could result in unacceptable snubber performance.
( )	( )	( )	Observe to see if there is any evidence that a snubber has experienced a potentially damaging transient, since the last examination.
( )	( )	( )	Observe the snubber and piston rod for excessive corrosion, solid deposits, which could impair operability of the snubber.
( )	( )	( )	Observe to ensure the security of essential threaded fasteners of the snubber installation such as tie rods and rear bracket bolts.
( )	( )	( )	Evidence of clamp binding due to missing spacers.
( )	( )	( )	Observe hydraulic snubbers for evidence of damage to external tubing. (external pipe configuration snubbers)
( )	( )	( )	Observe for evidence of torsional binding (i.e. mechanical snubber twisted along its axis by the pipe clamp and structural attachments).

____________________/______
Performer Signature Date

ATTACHMENT 2A
(Page 2 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR ALL SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- ___ - ___ Serial No. ______ Exam No. ____

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size ______
(Circle type snubber being examined)

PER No. ____________

2. Attachments to the foundation or supporting structure are functional. The following attributes will determine the acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
( )	( )	( )	Observe the exposed hanger structural steel, pipe clamps, base plates, lugs and other such plates of attachment for broken parts, deformation or other damage.
( )	( )	( )	Observe welds for visible damage at base plates, lugs, and other such plates of attachment.

________________/_____
Performer Signature Date

3. Fasteners for the attachment of the snubber to the component and to the snubber anchorage are functional. The following attributes will determine the acceptability in accordance with the appropriate acceptance criteria. Responses marked (UNAC) are unacceptable and require immediate notification of the Snubber Engineer/SE Designee at the time of discovery. Handling of deficiencies shall be completed in accordance with SPP-8.1 and SPP-3.1.

AC	UNAC	N/A	
( )	( )	( )	Observe to ensure the security of essential threaded fasteners such as anchorage bolts and pipe clamp bolts that are exposed.
( )	( )	( )	Observe to ensure clevis bolts or pins are properly installed.

________________/_____
Performer Signature Date

ATTACHMENT 2A
(Page 3 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR ALL SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. __________ Exam No. _____

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size ___________
(Circle type snubber being examined)

PER No. ____________________

Observe for the following attributes which may cause future problems but do not affect snubber operability or any acceptance criteria.

If any of the following problems are found, NOTE them in the Remarks section and NOTIFY the Snubber Engineer/SE Designee to disposition the finding on Attachment 4.

Pits, scratches, or rough places observed on the piston rod that would not contact the piston seal.

Cotter pins properly installed with legs bent sufficiently to prevent cotter pin from backing out.

Pivot pin retaining ring is properly installed, if required.

Security locking devices (i.e., locking tabs or wire) on snubber attachment bolts properly installed, if required.

Centerline of the clamp assembly and structural attachment offset (i.e., a misalignment with the snubber axis exists) by no greater than + or - 6 degrees based on the clearances between the rod eyes, or paddles, and the attachment clevis.
Contact of these parts, which produces a side load on the snubber is unacceptable.

Observe spacers are installed on each side of the snubber eye to reduce the misalignment and /or binding. Space shall not exceed 1/16 inch on either side or 1/8 inch total.

_____________________ / ______
Performer Signature Date

ATTACHMENT 2A
(Page 4 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR ALL SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size ________
(Circle type snubber being examined)

PER No. ________________

Snubber meets all visual acceptance criteria. N/A this step if functional test is required.

________________________/________
Snubber Engineer/SE Designee Date

Snubber is found acceptable functionally and meets all of the acceptance criteria. N/A this step if snubber meets all visual acceptance criteria.

________________________/________
Snubber Engineer/SE Designee Date

Based on the As-Found condition, including functional test if applicable, is the snubber operable? Yes ____ No ____
If "No", notify the Shift Manager/Unit Supervisor immediately of the inoperable snubber.

________________________/________
Snubber Engineer/SE Designee Date

Prior to the final review the Snubber Engineer/SE-Designee shall verify that all of the appropriate Attachments 2B, 2C, 3, 4, 5, or 6 have been completed and are attached with Attachment 2A.

Final Review ________________________/________
Snubber Engineer/SE Designee Date

REMARKS: ____

ATTACHMENT 2B
(Page 1 of 2)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR
BERGEN-PATTERSON, ANCHOR/DARLING, FRONEK HYDRAULIC SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- _____ - _____ Serial No. ________ Exam No. ____

Manuf. BERGEN-PATTERSON, ANCHOR/DARLING, FRONEK Size _________
(Circle type snubber being examined)

PER No. _________________

FLUID LEVEL ACCEPTABILITY FOR BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK HYDRAULIC SUNBBERS.

AC UNAC N/A

( ) ( ) ( ) If the Reservoir Plunger cannot be seen the reservoir is empty. The fluid level is unacceptable and the snubber is visually inoperable.

NOTIFY immediately the Snubber Engineer/Designee. Write a Work Order to REMOVE the snubber and take to the snubber test facility to have functional test performed.

Piston rod extension is the distance from end of front head to the punch mark or scribed line (nearest 1/8 inch)- 3/4 inch, as shown on Page 2 of 2 of this Attachment:

_____ -3/4 = _____ inches

Record the reading from the scale along the protective tube, as shown on Page 2 of 2 of this Attachment: _____ inches

Reservoir plunger reading from above: ________
Minus piston rod extension from above: - ________
Calculated value: ________

( ) ( ) ( ) If the calculated value above is greater than +2 inches, the fluid level is unacceptable.

( ) ( ) ( ) If the fluid level is unacceptable, but not empty, add GE SF 1154 Silicon fluid using a fluid gun with a special hydraulic fill coupling until the fluid level reading is at or approximately the same as the piston rod extension given above.

Record fluid PIC ticket and TIIC numbers below for any fluid added.

Fluid PIC ticket (SIR) ____________, TIIC ____________

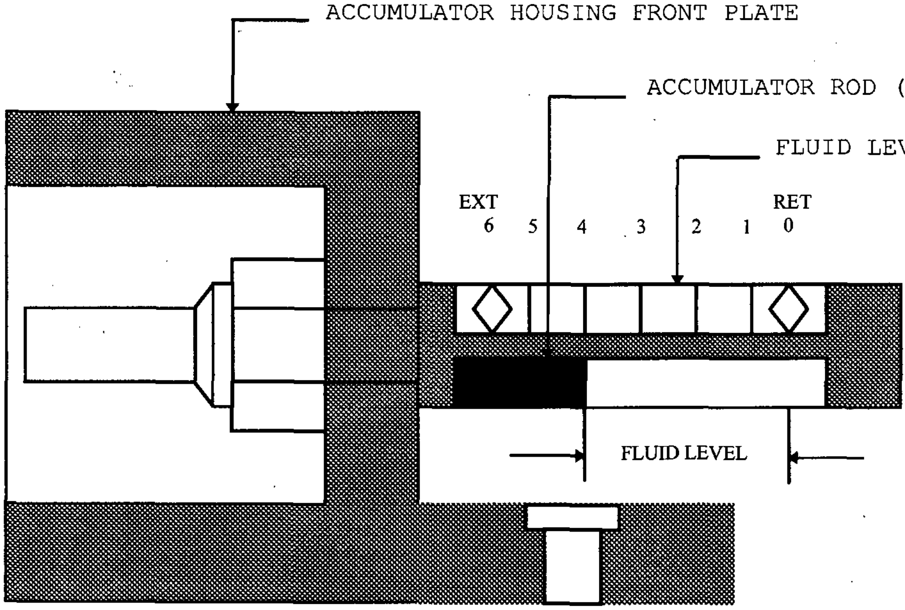
EXAMINE snubber for location and cause of any leaks. RECORD locations in Remarks on Attachment 1. NOTIFY the Snubber Engineer/SE Designee, to evaluate and document the unacceptable condition on Attachment 4. Take appropriate action.

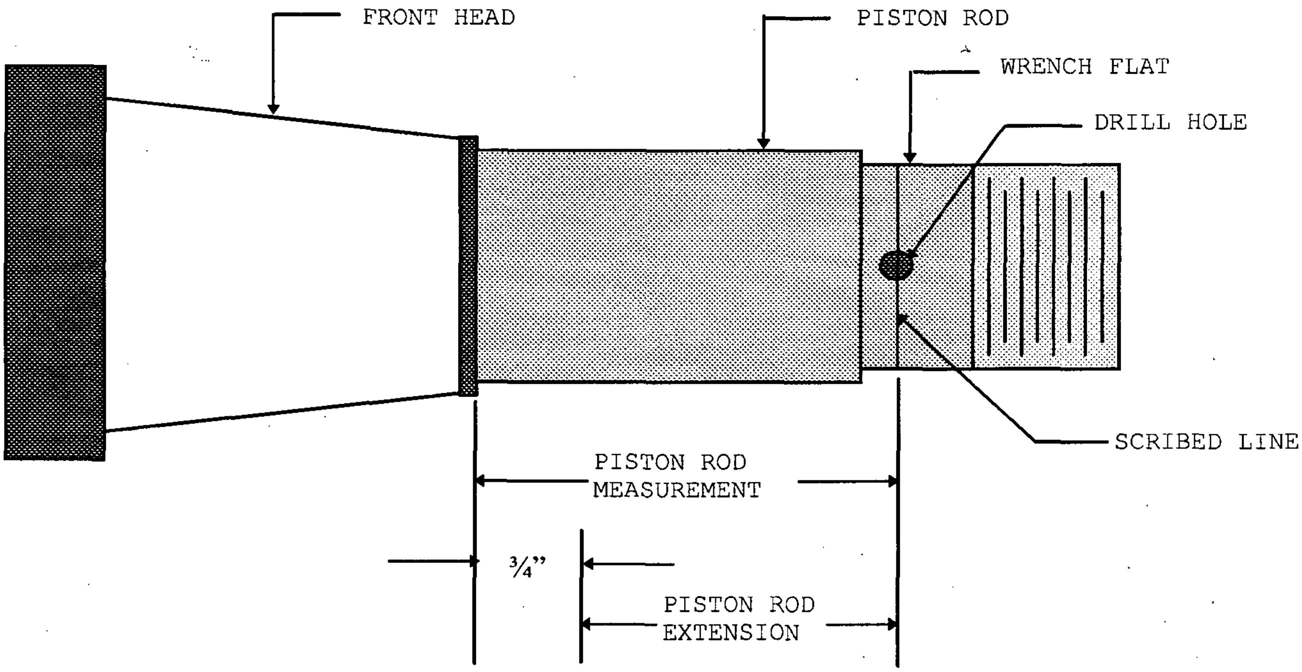
____________________ / _______
Performer Signature Date

ATTACHMENT 2B
(Page 2 of 2)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR
BERGEN-PATTERSON, ANCHOR/DARLING, FRONEK HYDRAULIC SNUBBERS

BERGEN-PATERSON, ANCHOR/DARLING, FRONEK FLUID LEVEL INDICATOR AND PISTON ROD MEASUREMENT METHODS





ATTACHMENT 2C
(Page 1 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR
LISEGA TORUS DYNAMIC RESTRAINT HYDRAULIC SNUBBERS

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. __________ Exam No.______

Manuf. LISEGA TORUS DYNAMIC RESTRAINT SNUBBERS Size ___________

PER No.____________________

FLUID LEVEL ACCEPTABILITY FOR LISEGA TORUS DYNAMIC RESTRAINT SUNBBERS.

AC UNAC N/A

( ) ( ) ( ) The fluid level is unacceptable if the reservoir is empty; the snubber is visually inoperable. NOTIFY immediately the Snubber Engineer/SE Designee. Write a Work Order to REMOVE the snubber and take to the snubber test facility to have functional test performed.

Piston rod extension is the distance, X, from the front head of the snubber to the outside edge mark on piston rod (nearest 1/8 inch), as shown on Page 2 of 4 of this Attachment. Record on Page 4 of 4 of this Attachment.

Reservoir plunger reading is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch)), as shown on Page 2 of 4 of this Attachment: L=______ inches, and record on Page 4 of 4 of this Attachment.

COMPARE the piston rod position X from above to the reservoir plunger reading to ensure measurements are within the minimum and maximum limits shown on the chart on Page 3 of 4 of this Attachment.

If the fluid level is below L minimum, add Lisega AP-280 Silicon fluid using a fluid gun with a special hydraulic fill coupling to the maximum fluid level reading, as shown in the chart on Page 3 of 4 of this Attachment. If the fluid level is above the L maximum value, contact the Snubber Engineer/SE Designee.

Record fluid PIC ticket, TIIC numbers, and optimum/maximum fluid level added above and complete Page 4 of 4 of this Attachment.

Fluid PIC Ticket (SIR) __________, TIIC ___________

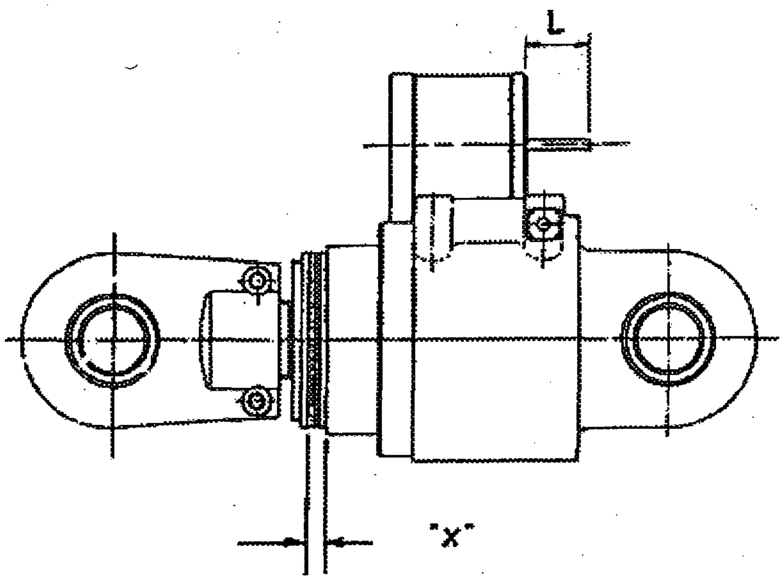
EXAMINE snubber for location and cause of any leaks. RECORD locations in Remarks on Attachment 1. NOTIFY the Snubber Engineer/SE Designee, to evaluate and document the unacceptable condition on Attachment 4 and take appropriate action.

______________________/________
Performer Signature Date

ATTACHMENT 2C
(Page 2 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR
LISEGA TORUS DYNAMIC RESTRAINT HYDRAULIC SNUBBERS

LISEGA MINIMUM AND MAXIMUM FLUID LEVEL PLUNGER
AND PISTON POSITION MEASUREMENT IN THE FIELD



ATTACHMENT 2C
(Page 3 of 4)

SNUBBER VISUAL EXAMINATION CHECKLIST FOR
LISEGA TORUS DYNAMIC RESTRAINT HYDRAULIC SNUBBERS

LISEGA MINIMUM AND MAXIMUM FLUID LEVEL PLUNGER
AND PISTON POSITION MEASUREMENT IN THE FIELD

If the as-found plunger position "L" is below the minimum value given, ADD Lisega AP-280 fluid to the snubber to bring the reservoir, as close as possible, to its optimum (maximum) level. No functional testing of the Lisega Torus Dynamic Restraint Snubber is required due to this refilling operation. The Lisega Torus Dynamic Restraint Snubbers are not considered inoperable until the reservoir is completely empty. This can be identified when the reservoir plunger is flush with the top of the reservoir plate. The snubber will be considered inoperable when the "L" dimension is equal to "0".

Nomenclature:

X - Measurement of the snubber piston rod position in inches from the front head of the snubber to the outside edge marked piston rod.

L Minimum - The minimum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

L Maximum - The maximum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

If the X measurement is between the numbers given in the table below for "X", then go to the next lower reading for "X" to determine the L Minimum and L Maximum.

X (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.52	3.31
0.125	2.43	3.22
0.250	2.34	3.13
0.375	2.26	3.04
0.500	2.17	2.96
0.625	2.08	2.87
0.750	1.99	2.78
0.875	1.91	2.69
1.000	1.82	2.60
1.125	1.73	2.52
1.250	1.64	2.42
1.375	1.55	2.34
1.500	1.47	2.25

ATTACHMENT 2C
(Page 4 of 4)

SURVEILLANCE INSTRUCTION DATA SHEET
LISEGA LARGE BORE TORUS DYNAMIC RESTRAINT
SNUBBER VISUAL EXAMINATION CHECKLIST

Work Order :________________ Outage/Cyle (RFO):_______

Fluid Type :__________, Visual Exam Date:________

Fluid PIC Ticket (SIR):_______, TIIC:_________.

Ex No.	TDR UNID	TDR No.	Serial Number	Piston Rod Pos. "X"(in)	Reservoir Plunger Reading "L"(in)	*Optimum/ Max. As-Left Fluid Level (in)	Performer Signature/ Date

NOTE:

1) *-- Optimum/Maximum Fluid Level is reservoir plunger reading measured after adding the Lisega AP-280 silicon fluid to the snubber.

ATTACHMENT 3
(Page 1 of 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners, used for attachment of snubber(s) to a system/component and to snubber anchorage, are discovered loose or missing. This Attachment may be completed on the computer, as a form, if desired.

Unit 3 Snubber UNID No. 3-SNUB- - __________ Serial No. __________ Exam No. ______

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK (Circle type snubber being examined) Size __________

PER No. ____________________

1. Describe the discovered condition(s):

2. If possible, determine cause:

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.

4. Describe the corrective action(s) and provide the "As-Found" test results.

Evaluated by: ______________________________ / ______
Snubber Engineer/SE Designee Date

ATTACHMENT 4

(Page 1 of 2)

ENGINEERING EVALUATION
OF UNACCEPTABLE INDICATION

This Attachment may be completed on the computer as a form, if desired.

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. __________ Exam No. _____

Manuf. ANCHOR/DARLING,BERGEN-PATTERSON,LISEGA,PSA,FRONEK Size ___________
(Circle type snubber being examined)

PER No. ____________________

1. Describe the unacceptable indication(s) observed.

2. What is the cause of the indication(s) (i.e., vibration, water leaking on surface, possible failure to torque at last reinstallation, etc.)?

3. What is the basis for the conclusions reached by question 2 above?

4. Which additional snubbers are suspected to be subject to the same unacceptable indication(s)?

ATTACHMENT 4
(Page 2 of 2)

ENGINEERING EVALUATION
OF UNACCEPTABLE INDICATION

This Attachment may be completed on the computer as a form, if desired.

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. __________ Exam No. _____

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size __________
(Circle type snubber being examined)

PER No. ____________________

5. What further examination(s) and/or test(s) of the initial and other suspect snubber(s) are to be performed?

6. What are the results of the examination(s) and/or test(s) performed by Step 5 above, and what changes in the initial evaluation should be made?

7. What corrective action(s) is/are to be taken for the initial snubber and/or any other suspect snubbers?

8. Has/have the corrective action(s) been taken? YES ☐ NO ☐

9. Number of snubbers, initial and other suspect snubbers, that will affect the next visual inspection interval. _______

Evaluated by: ______________________________/________
Snubber Engineer/SE Designee Date

ATTACHMENT 5
(Page 1 of 2)

ENGINEERING EVALUATION OF TRANSIENT EVENT INDICATION(S) AND EFFECT(S)

This Attachment may be completed on the computer as a form, if desired.

Unit 3 Snubber UNID No. 3-SNUB-_____-_____ Serial No. __________ Exam No._____

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size __________
(Circle type snubber being examined)

PER No.____________________

1. What is/are the indication(s) that a potentially damaging transient event has taken place?

2. Which snubber installation(s) are suspected of being subject to the transient?

3. What are the result(s) of the visual examination for bent or broken parts and other signs of damage to the installation(s)? (Attach extra sheets, if necessary, to detail the results for each suspect installation(s).

ATTACHMENT 5
(Page 2 of 2)

ENGINEERING EVALUATION OF TRANSIENT EVENT INDICATION(S) AND EFFECT(S)

This Attachment may be completed on the computer as a form, if desired.

Unit 3 Snubber UNID No. 3-SNUB- - ________ Serial No. ________ Exam No. ______

Manuf. ANCHOR/DARLING, BERGEN-PATTERSON, LISEGA, PSA, FRONEK Size ________
(Circle type snubber being examined)

PER No. ____________________

4. What additional test(s), NDE examination(s), etc., is/are required to be performed to verify structural integrity of the snubber(s) and its attachment(s)? (PSA snubbers are to be stroked to verify they are not jammed or broken internally.)

5. What are the results of the additional test(s) and/or examination(s) performed in Section 4?

6. What is/are the corrective action(s) to be taken to correct the problem(s) found?

7. Has/have the corrective action(s) been completed for all suspect snubbers? YES ☐ NO ☐

8. How many of the snubber installations are to be counted as inoperable to affect the surveillance schedule?

Evaluated by: ______________________________/______
Snubber Engineer/SE Designee Date

ATTACHMENT 6
(Page 1 of 6)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
FLUID LEVEL CHECK INSTRUCTIONS

NOTES:

(1) A BERGEN-PATERSON Torus Dynamic Restraint (TDR) found with fluid below the minimum level shown in Table 1, shall be refilled to its optimum level as shown in Table 2. However, the TDR is not inoperable until reservoir fluid level is equal to or less than 0.375 inches.

Also, a leaking BERGEN-PATERSON Torus Dynamic Restraint, for which reservoir filling to maintain acceptable fluid level is required at time intervals of 3 hours or less, shall be declared inoperable.

(2) The minimum fluid level shown in Table 1 for the BERGEN-PATERSON Torus Dynamic Restraints is dependent on the fluid temperature.

(3) If the restraint temperature does not match one of the temperatures in either Table 1 or 2, go to the next higher temperature for the minimum or optimum level.

INSTRUCTIONS:

1. OBTAIN permission from the Shift Manager/Unit Supervisor to perform this verification.

2. NOTIFY the Unit Operator and Snubber Engineer/SE Designee that the SI is beginning.

3. ENTER the required information on the Surveillance Instruction Review Form, Attachment 1.

4. MEASURE the surface temperature, at the reservoir of the BERGEN-PATERSON Torus Restraint, at the time of surveillance performance. RECORD the surface temperature, the calibrated thermometer unique identifier (UNID) number, and calibration due date on Attachment 6.

5. RECORD the calibrated micrometer unique identifier (UNID) number and the calibration due date on Attachment 6.

6. MEASURE the as-found distance the plunger extends above the reservoir end cap, to the nearest 0.05 inch as shown on Page 4 of 7 of this Attachment, using a calibrated M&TE Measuring Test Equipment to determine the as-found fluid level. (The value indicated on Page 4 of 7 of this Attachment should be read as 1.250").

7. RECORD the as-found plunger extension/reading, and location(s)/source(s) of any leaks()in the appropriate space on Attachment 6.

ATTACHMENT 6
(Page 2 of 6)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
FLUID LEVEL CHECK INSTRUCTIONS

8. If the as-found plunger reading is equal to or less than 0.375 inches, NOTIFY the Snubber Engineer/SE Designee immediately that the snubber is inoperable. ENTER on Attachment 1 the name of Shift Manager/Unit Supervisor notified.

9. When the snubber/restraint is inoperable an Engineering Evaluation of Unacceptable Indication, Attachment 4, is required to be completed by the Snubber Engineer/SE Designee or Site Engineering Civil personnel.

10. ENTER in Attachment 1 the name of Shift Manager/Unit Supervisor notified when snubber operability is restored.

11. If the as-found plunger reading is below the value given in Table 1 for the appropriate temperature, the fluid level shall be refilled to the optimum level. If the as-found plunger reading is equal to or above the value given in Table 1 for the appropriate temperature, the fluid reservoir may be refilled to the optimum level. No functional testing of the BERGEN-PATERSON Torus Dynamic Restraint is required due to the fluid refilling operation.

12. CLEAN the snubber by wiping down with clean rags or a nylon brush wetted with solvent, then WIPE the snubber dry with a clean rag.

13. ENTER the as-left fluid level reading for each snubber on Attachment 6.

14. EXAMINE each hydraulic snubber for other sources of fluid leak(s) and LIST in the appropriate space on Attachment 6.

15. VERIFY all data meets the acceptable limits.

16. VERIFY the Data Package Attachment 6, Cover Sheet Attachment 1, and other applicable Attachments have been completed properly.

ATTACHMENT 6

(Page 3 of 6)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
FLUID LEVEL CHECK INSTRUCTIONS

TABLE 1

TEMPERATURE (Degrees (F)	MINIMUM LEVEL (Inches)	TEMPERATURE (Degrees (F)	MINIMUM LEVEL (Inches)	TEMPERATURE (Degrees (F)	MINIMUM LEVEL (Inches)
50	.90	67	1.17	84	1.44
51	.92	68	1.19	85	1.45
52	.94	69	1.20	86	1.47
53	.95	70	1.22	87	1.48
54	.97	71	1.23	88	1.50
55	.99	72	1.25	89	1.51
56	1.00	73	1.26	90	1.53
47	1.01	74	1.28	91	1.54
58	1.03	75	1.29	92	1.56
59	1.05	76	1.31	93	1.58
60	1.06	77	1.33	94	1.59
61	1.08	78	1.34	95	1.61
62	1.09	79	1.36	96	1.62
63	1.11	80	1.37	97	1.64
64	1.12	81	1.39	98	1.65
65	1.14	82	1.40	99	1.67
66	1.15	83	1.42	100	1.69

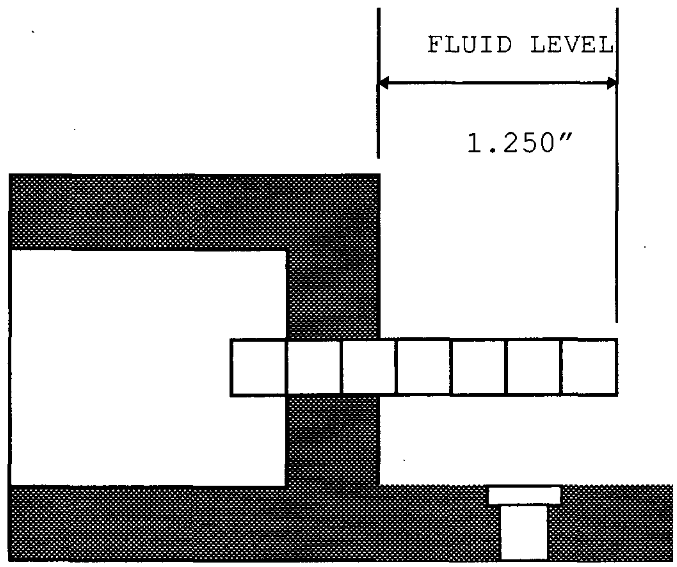
ADD fluid to the snubber to bring the reservoir, as close as possible, to its optimum level, as determined from Table 2, using the appropriate temperature recorded earlier.

TABLE 2

TEMPERATURE (Degrees (F)	OPTIMUM LEVEL (Inches)	TEMPERATURE (Degrees (F)	OPTIMUM LEVEL (Inches)	TEMPERATURE (Degrees (F)	OPTIMUM LEVEL (Inches)
50	3.33	67	3.07	84	2.80
51	3.31	68	3.05	85	2.78
52	3.30	69	3.03	86	2.77
53	3.28	70	3.02	87	2.75
54	3.27	71	3.00	88	2.74
55	3.25	72	2.99	89	2.72
56	3.24	73	2.97	90	2.71
47	3.22	74	2.96	91	2.69
58	3.21	75	2.94	92	2.67
59	3.19	76	2.92	93	2.66
60	3.17	77	2.91	94	2.64
61	3.16	78	2.89	95	2.63
62	3.14	79	2.88	96	2.61
63	3.13	80	2.86	97	2.60
64	3.11	81	2.85	98	2.58
65	3.10	82	2.83	99	2.57
66	3.08	83	2.82	100	2.55

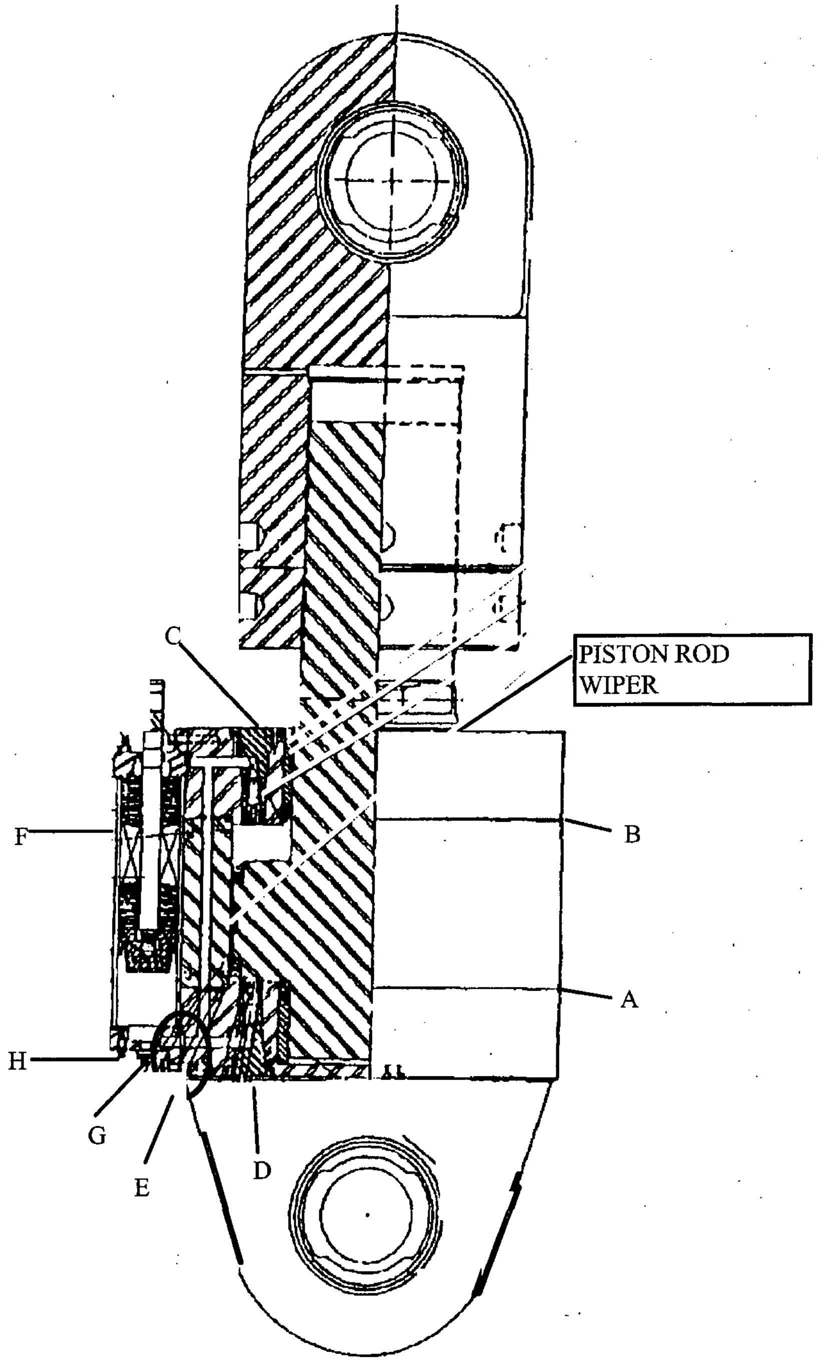
ATTACHMENT 6
(Page 4 of 6)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT RESERVOIR LEVEL INDICATOR READING



ATTACHMENT 6
(Page 5 of 6)

BERGEN-PATERSON TORUS DYNAMIC RESTRAINT LEAKAGE LOCATION POINTS



ATTACHMENT 6
(Page 6 of 6)

SURVEILLANCE INSTRUCTION DATA SHEET
BERGEN-PATERSON TORUS DYNAMIC RESTRAINT
SNUBBER VISUAL EXAMINATION CHECKLIST

Thermometer UNID ____________________ M&TE Test Equip. UNID ______________

Calibration Due Date ________________ Calibration Due Date _______________

Fluid PIC Ticket (SIR) ______________ TIIC ____________

EXAM NO.	TORUS DYNAMIC RESTRAINT	UNID	AS-FOUND FLUID LEVEL (inches)	LEAK LOCATION	AS-LEFT FLUID LEVEL (inches)	RESTRAINT SURFACE TEMP.	*PERFORMER SIGNATURE/ DATE

LEAK LOCATION KEY

A) Base head seal
B) Rod head seal
C) Base valve seal
D) Rod valve seal
E) Reservoir to snubber body seal
F) Reservoir body
G) Reservoir fill plug
H) Reservoir bleed plug
I) Others (list below)

*SIGNATURE ATTESTS THAT:

1) Location and cause of any leaks has been identified.
2) Fluid level has been properly determined per Table 1.
3) Fluid added per Table 2, if required.

Attachment C

BFN SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2A,

Functional Testing of Mechanical Snubbers

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2A

FUNCTIONAL TESTING OF MECHANICAL SNUBBERS

REVISION 4

PREPARED BY: B. M. PEDROSO JR. PHONE: 3177

RESPONSIBLE ORGANIZATION: SITE ENGINEERING- CIVIL DESIGN

APPROVED BY: ERIC J. FREVOLD DATE: 03/11/2006

EFFECTIVE DATE: 03/112006

LEVEL OF USE: CONTINUOUS USE

QUALITY-RELATED

REVISION LOG

Procedure Number: 0-SI-4.6.H-2A

Revision Number: 4

Pages Affected: Cover Sheet, Revision Log, 22 and 24

Description of Change: IC-005

This procedure is being revised to distinguish between sub-groups 3a and 3b in Appendix A.

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing of mechanical snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety related systems, inside and outside of the drywell.

1.2 Scope

NOTES:

(1) For the purposes of this instruction, the snubbers are categorized into two major groups, based on whether the snubbers are accessible or inaccessible during reactor operation. These major groups may further be divided into subgroups based on design of the snubbers or may be established by engineering analysis based on environment or other failures which may be expected to affect the operability of the snubbers within the group.

(2) The terms group or category may be used interchangeably throughout this instruction.

(3) The remaining portions of Technical Requirements TR 3.7.4 pertains to the visual examination of snubbers and is implemented by Surveillance Instructions 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

1.2.1 Guidance to Perform the Functional Test

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Pacific Scientific Company (PSC) mechanical snubbers addressed as PSA-1/4, -1/2, -1, etc. for Unit 1, 2, and 3 as follows:

- Removal and reinstallation of Pacific Scientific mechanical snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 1, 2, 2A, and 5.
- Provides the requirements for functional testing and service life monitoring of Pacific Scientific mechanical snubbers. This instruction covers subgroups 3, 4 and 6 (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements (TR)functional testing requirements, Surveillance Instructions, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D, and 0-SI-4.6.H-2E must also be performed.
- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction shall be used to verify operability of mechanical snubbers suspected inoperable during performance of the visual examination SI's.

1.2 Scope (Continued)

- All PSA-1/4 snubbers (inside the drywell) shall be stroke tested during each refueling outage, as close to the end of the outage as possible.

1.3 Frequency/Conditions

1.3.1 This Surveillance Instruction shall be performed in accordance with TSR 3.7.4.2 and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1 Visual Examination of Hydraulic and Mechanical Snubbers.

1.3.2 This instruction may be performed at any time for snubbers outside the drywell (preferably no earlier than 60 days prior to the start of the outage), but may only be performed at a time when the drywell may be entered for snubbers inside the drywell.

1.3.3 All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

1.3.4 Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping in the drywell are exempt from the operability requirement when the steam line plugs are installed in the reactor vessel.

1.3.5 Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

1.3.6 A snubber removed from a safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate limiting condition statement for that system.

1.3.7 For an inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does not meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM.
The engineering evaluation is to determine if the component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be documented on Attachment 4.

1.3 Frequency/Conditions (Continued)

1.3.8 Alternately, for a snubber removed and not replaced within 72 hours, or an inoperable snubber not replaced or restored within 72 hours, operability of the supported system may be verified based on an engineering evaluation of the system functional capability with the removed or inoperable snubber.

1.3.9 Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

1.3.10 For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found, or all snubbers in that subgroup have been tested, or all suspect snubbers identified by the failure analysis have been tested, as applicable. The failure analysis shall be used, as applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers which may also be subject to the same failure mode.

1.3.11 New, replaced or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

2.1 Technical Requirements Manual, TR 3.7.4 Snubbers.

2.2 1-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.3 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.4 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.5 MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

2.6 BFN-VTM-P029-0010, Pacific Scientific Instruction Manual for Repair, Overhaul, Installation and Maintenance of Mechanical Shock Arrestors.

2.7 0-TI-398, Snubber Program Procedure

2.8 SPP-3.1, Corrective Action Program

2.9 SPP-8.1, Conduct of Testing.

3.0 PRECAUTIONS AND LIMITATIONS

NONE

4.0 PREREQUISITES

4.1 Six months prior to each refueling outage, the supply of mechanical snubbers in Power Stores shall be reviewed and a minimum of 10% of each size shall be reserved and ensure the proper paperwork is with them to comply with the requirements of the Section XI Repair and Replacement Program. This paperwork shall include the purchase contract and Certificate of Compliance for the material.

4.2 The force gauges to be used for field testing, using the Push-Pull gauges, should be sized such that the test load does not fall below 10% or greater than 90% of the range on the face of the gauge. If this occurs then a smaller gauge or larger gauge should be obtained and the snubber retested.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

NONE

6.0 ACCEPTANCE CRITERIA

6.1 Responses which fail to meet the following acceptance criteria require immediate notification of the Snubber Engineer/SE Designee at the time of failure.

6.2 The snubber functional test shall verify that:

6.2.1 Activation (restraining action) is achieved, in both tension and compression.

6.2.2 The stroke setting and security of the fasteners for attachment of the snubber(s) to the component and to the snubber anchorage shall be verified on snubber(s) selected for functional tests.

6.2.3 The drag force (force required to initiate or maintain motion) of the snubber, is not great enough to over stress the supported component or system during thermal movement, or to indicate impending failure of the snubber.

6.2.4 The drag force shall not exceed the maximum of 5% of the snubber rated load, Table 6.6-2, or Attachment 6, if applicable. As-Found drag forces greater than 4% but less than 5% of the snubbers rated load shall be evaluated for impending failure.

6.0 ACCEPTANCE CRITERIA (Continued)

TABLE 6.2-1
MAXIMUM ACCEPTABLE DRAG FORCE VS. SNUBBER SIZE

SNUBBER SIZE	ACCEPTABLE DRAG FORCE (lbs.)
PSA-1/4 & 1/2 NF	32.5
PSA-1 NF	75.0
PSA-3 NF	300.0

SNUBBER SIZE	ACCEPTABLE DRAG FORCE (lbs.)
PSA-10 PRE-NF	500.0
PSA-10 NF	750.0
PSA-35 NF	2500.0
PSA-100 NF	6000.0

6.2.5 "As-Found" drag forces greater than the maximum acceptable drag force from Table 6.2-1, Table 6.2-2, or Attachment 6 shall require a supported component or system analysis by Site Engineering Civil.

NOTES:

(1) Shaded areas in the following table represent the envelope of maximum acceptable snubber drag force.
(2) The combined drag force of multiple snubbers in a given support direction shall not exceed the tabulated values.
(3) The next smaller pipe size should be used for sizes not shown in the table. Smaller sizes require a case specific evaluation.

Table 6.2-2
MAXIMUM ACCEPTABLE SNUBBER DRAG FORCE VS. PIPE SIZE

PIPE SIZE (inches)	MAXIMUM ACCEPTABLE DRAG FORCE (lbs.) 32.5	75	300	750	2500	6000
3/4						
1						
2						
3						
4						
6						
8						
12						
16						
20						
24						

6.0 ACCEPTANCE CRITERIA (Continued)

6.2.6 For snubber(s) specifically required not to displace under continuous load, the ability of the snubber(s) to withstand load without displacement shall be verified.

6.2.7 The As-Found stroke setting shall be within the limits shown on the design drawing or as designated by Site Engineering Civil.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

7.1.1 A thorough briefing should be conducted on SI performance prior to starting.

7.1.2 The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

7.1.3 Appropriate General Employee Training (GET) (including respirator training) should be received by test personnel prior to performing this SI.

7.1.4 Training required for the testing of mechanical snubbers shall meet the requirements of Task Number MMY 502.

7.2 Preparation of Test Data Package

7.2.1 EXCLUDE the snubbers from the initial test lot (sample plan) which are scheduled for deletion in accordance with approved Design Change Notices.

7.2.2 EXCLUDE the snubbers until the next outage from the initial test lot (sample plan) which are to be added in accordance with approved Design Change Notices.

7.2.3 SELECT snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

7.2 Preparation of Test Data Package (Continued)

7.2.4 DETERMINE the initial test lot (sample plan) as follows:

- SELECT 10 percent of the snubbers from subgroups 3, 4 and 6 (see Appendix A).
- SELECT the snubbers with the most time from the previous test.
- Sample should be weighted to include more snubbers from severe service areas (i.e., inside the drywell).
- SELECT snubbers that have experienced severe transients.
- SELECT snubbers of various sizes.
- SELECT snubber(s) that must be tested per an Engineering Evaluation, if applicable.

NOTE:

Snubbers that failed because of location are to be tested separately from the initial test lot (sample plan).

- DO NOT SELECT snubber(s) which failed during the last surveillance test.
- FILL out the applicable section(s) of Attachment 2 or 2A.

7.2.5 REVIEW the applicable support drawings to verify the location and any conditions that will require special preparation or equipment.

7.2.6 REQUEST scaffold or similar devices to be built or are available, as necessary.

7.2.7 RECORD the date, time and other required information on Attachment 1, and prior to REMOVAL of a snubber per MPI-0-000-SNB004 for functional test, RECORD the "As-Found" Stroke Setting in Attachment 2 or 2A.

7.3 "As Found" Drag Force Test Using Push-Pull Force Gauges

NOTE:

Drag force is the force required to initiate and maintain snubber movement at a constant velocity. This test is performed prior to the Activation test.

7.3.1 REMOVE the snubber in accordance with MPI-0-000-SNB004, record the "As-Found" stroke setting in Attachment 2 as required, and perform the drag force test.

7.3 "As Found" Drag Force Test Using Push-Pull Force Gauges (Continued)

7.3.2 PREPARE the snubber for the drag force test, in approximately the horizontal position. The snubber should be supported so that no binding can occur during the test.

7.3.3 RECORD all of the Measuring and Test Equipment (M&TE) and calibration information from the two (2) force gauges which will be used, on Attachment 2, as appropriate.

7.3.4 Wrap wire through the spherical bearing of the snubber for connecting the gauges to perform the drag force and activation test.

7.3.5 CONNECT the first force gauge to the wire in the spherical bearing of the snubber.

****

CAUTION

If a force gauge is dropped or extended past its upper limit, or closed hard against its stop, discontinue use and note this in the remarks on Attachment 2, as appropriate. Obtain a new gauge to replace the gauge for which use was discontinued.

****

7.3.6 ALIGN the snubber to approximately the horizontal position to ensure that the effects of the heavy portion of the snubber, that moves during the test, does not affect the drag force measurement significantly.

7.3.7 APPLY a steady force in the direction of the most available travel, (extension or retraction) gradually to initiate and maintain motion at a very slow rate (approximately 5 inches per minute) and continue for the full length of the stroke.

7.3.8 OBSERVE the force gauge readings, keeping the snubber approximately horizontal.

7.3.9 STOP the motion about 1/4 inch from the end of the stroke length.

7.3.10 RECORD on Attachment 2 the force gauge values, under the appropriate direction of travel.

7.3.11 Steps 7.3.5 through 7.3.10 shall be performed three (3) times in each direction and an average taken of the three (3) values.

7.3.12 If the drag force exceeds 5 percent of the rated load, RECORD in the remarks section of Attachment 2 where, on the stroke length, the highest drag force occurred and what that force was.

7.3.13 DISCONNECT the first force gauge from the snubber.

7.3 "As Found" Drag Force Test Using Push-Pull Force Gauges (Continued)

7.3.14 CONNECT the second force gauge to the wire in the spherical bearing of the snubber and REPEAT Steps 7.3.6 to 7.3.12.

7.3.15 DISCONNECT the second force gauge from the snubber.

7.3.16 If the snubber appears to be locked in place during the performance of the drag force test in the field additional force, up to the rated load of the snubber, may be applied.

7.3.17 If the snubber cannot be moved in the field, remove the snubber in accordance with MPI-0-000-SNB004 and transport it to the snubber test facility for testing on the appropriate API/Barker test machine.

7.3.18 If the snubber is found to be locked in place after testing in the snubber test facility, PERFORM the following:

- NOTIFY Snubber Engineer/SE Designee for determination of further action.
- If the snubber is a Pre-NF (white) PSA-10, PERFORM Appendix E prior to performing the functional test of the new snubber.
- FUNCTIONALLY TEST the new snubber in accordance with this procedure and document the results on Attachment 2A, as appropriate.
- REPLACE the new snubber in accordance with MPI-0-000-SNB004.

7.3.20 COMPLETE Attachment 2, 2A, 5 and RETURN to the Snubber Engineer/SE-Designee to perform Section 7.6.

7.4 Activation and Release Test

****

CAUTION

Never stroke the snubber to the end of its full stroke length at a fast rate. Internal damage may result when the snubber comes to a sudden stop.

****

7.4 Activation and Release Test (Continued)

NOTES:

(1) Activation verification may be performed manually or with power assist devices and gauges, provided to indicate changes in the snubber resistance.

(2) Orientation of the snubber is of no consequence during the activation test.

7.4.1 START the snubber activation test near the end of the snubber stroke length.

7.4.2 APPLY a slight force to stroke the snubber at a uniform speed for approximately 1/3 to 1/2 of its stroke length.

7.4.3 APPLY an increasing force to increase the speed of the snubber, and perform the following:

- ENSURE that the snubber mechanism resists the attempted increase in speed and that the force required to stroke the snubber at the increased speed is greater than the force required to keep the snubber mechanism in motion (drag force). Increased resistance indicates activation has taken place. In addition, a "click" sound may also be an indication of activation, due to the capstan spring tangs, meeting the grooves in the inertial mass, causing the clutch spring to engage. This "click" sound may be heard at a moment when the stroke direction is being changed rapidly.

- ENSURE the snubber (motion) continues after activation takes place (does not jam at activation).

7.4.4 REPEAT Steps 7.4.1 through 7.4.3 in the opposite direction of travel.

7.4.5 RECORD the results and any comments about the activation verification, in both directions of travel on Attachment 2, as appropriate.

7.4.6 If any snubber selected for functional testing either fails to activate or fails to move, the cause will be evaluated, and if caused by a manufacturer or design deficiency, all snubbers of the same design and subject to the same defect shall be functionally tested. This testing requirement shall be independent of the requirements stated for snubbers not meeting the functional test acceptance criteria.

7.4.7 If a snubber fails to meet the functional test acceptance criteria, PERFORM the following:

- NOTIFY the Snubber Engineer/SE-Designee for determination of further actions.

7.4 Activation and Release Test (Continued)

- Request from Site Engineering a Case Specific Acceptance Criteria evaluation using Attachment 6, prior to selecting an expanded sample.
- Request a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.
- SELECT a subsequent test lot in accordance with Steps 7.4.8 through 7.4.12, if required.

NOTE:
The subsequent test lot (sample plan) shall consist of an additional 10 percent of the remainder of the subgroup of snubbers being functionally tested. The testing shall continue until no additional inoperable snubbers are found within the subsequent test lot or all snubbers of the original lot of snubbers have been tested or all suspect snubbers identified by the failure analysis have been tested, as applicable.

7.4.8 DETERMINE the subsequent test lot (sample plan), as required.

7.4.9 SELECT a number of snubbers equal to 10 percent of the remaining from the original test lot (sample plan) of the subgroup.

7.4.10 SELECT the other parallel snubber from the same location, if one snubber failed at that location.

7.4.11 SELECT the snubbers, as required, by the snubber failure analysis and FOLLOW Step 7.2.4.

7.4.12 SELECT a subsequent test lot (sample plan) equal to 10 percent of the original test lot (sample plan) for snubber(s) that failed during the last surveillance test and failed again during the subsequent surveillance test.

7.4.13 PERFORM Sections 7.3 through 7.5, as required, for each subsequent test lot (sample plan).

7.5 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench

7.5.1 If the extension or one of the end attachments has been removed, INSTALL the appropriate end attachments located in the snubber test facility.

7.5.2 ENSURE the test bench has been Warmed Up in accordance with Appendix B of this procedure.

NOTE:
The following describes a suggested procedure for "Testing a Snubber" using the STB 200 Snubber Test Bench with the upgraded Windows Software Operations Manual.

7.5 "As-Found" and "As-Left" Functional Test Using the STB 200 Test Bench (Continued)

7.5.3 **POWERING UP THE TEST SYSTEM**

TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on.
TURN ON the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit.
ENSURE that all emergency stop buttons are pulled out.

7.5.4 **STARTING THE SOFTWARE**

Once the computer has "Booted Up", the Windows Desktop will be displayed. SELECT the "STB 200" icon and double click on it, this will Start the Test program.
The "LOG ON" prompt window will appear. ENTER you user name and password in either upper or lower case letters. All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

7.5.5 **DAILY CALIBRATION CHECK**

PERFORM the Daily Calibration Check using Section 3 of Appendix B, and sign the daily calibration form.

After the daily calibration check has been completed, and the Daily Calibration Report is "SATISFACTORY", proceed on testing a snubber.

7.5.6 **TESTING A SNUBBER**

7.5.6.1 **Pick the Snubber Type**

Using the Snubber Pull Down List in the User Supplied Information block, SELECT the Type Snubber to be tested.

7.5.6.2 **Enter the Header Information**

FILL in the other information as indicated in the User Supplied Information block.

7.5.6.3 **Running the Test**

1. ***Pick the Test***
   CLICK on the Type of Test (i.e., "As-Found" or "As-Left") desired.

2. ***Start the Test***
   CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

3. ***Tare weight Window***
   This window allows the User to "zero out" any offset load that the load cell may be reading. This should be DONE BEFORE installing the snubber in the test bench.

7.5 <u>"As-Found" and "As-Left" Functional Test Using the STB-200 Test Bench</u> (Continued)

7.5.6 **TESTING A SNUBBER** (Continued)

7.5.6.3 **Running the Test** (Continued)

3. ***Tare weight Window*** *(Continued)*
   Wait for the "Raw Reading" to settle (as far as possible), and then Click "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb.
   The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired.
   Once the readings are as desired, Click the "Continue" button.

   ENSURE the correct load cell is connected to the machine.

   CHOOSE the proper bushings and pins for the snubber being tested, then INSTALL the bushings in both clevis attachments on the machine.

4. ***Stroke and Position Window***
   INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. Adjust the backstop and or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver.

   INSTALL the pins through the bushing and the snubber spherical bearings.

   ONCE the snubber has been pinned, the snubber's piston position (distance from the fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

   If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated.
   The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus the 1/2" safety zones), the calculated center position and the bottomed out position for the snubber.

7.5 "As-Found" and "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

7.5.6 **TESTING A SNUBBER** (Continued)

7.5.6.3 **Running the Test** (Continued)

*4. **Stroke and Position Window** (Continued)*

Once the data has been successfully entered, TIGHTEN the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.
ENTER the snubber number, system number, serial number, and test equipment information on Attachment 2A or 5 as required, and Click on "Continue with Test" to continue the testing.

5. ***If an Activation Test is Selected***

After all the above steps has been completed, and PRIOR to starting an "As-Found" Activation Test, the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the set point and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

- OBSERVE that the snubber activates in both directions, to establish operability of the snubber in the "As-Found" condition.

- RECORD all necessary information on Attachment 2A or 5, as appropriate.

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

NOTE: Forcing a test may allow the machine to overstress the snubber during the test!

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

7.5 "As-Found" and "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

7.5.6 **TESTING A SNUBBER** (Continued)

7.5.6.3 **Running the Test** (Continued)

6. ***If Drag Test is Selected***

If a Drag Test (i.e., **ID, AC,** and **FD test** sequence for the "As-Left", and **AC, FD** test sequence for "As-Found" functional test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke, and that the Raw Test Data graphed in real time is reviewed in order to:

- VERIFY that the drag force of the snubber is less than 5% of the rated load, as shown in Table 6.2-1.
- RECORD this information on Attachment 2A or 5, as appropriate.

7. ***Printing the Results***

After the test is complete, the calculations appropriate to that test are performed and the results are displayed on the screen. This allows the user to review and determine if the "As-Found" test results meet the "As-Left" acceptance criteria in Section 6.2, and plot the test results:

- If the results are within the "As-Left" acceptance range, Click on the "Print Test" button to open the standard Windows printer dialog box. SELECT the proper printer, and click "OK" to start the printing.
- RECORD these information on Attachment 2A or 5, as appropriate.
- ATTACH the Printed Results in Attachment 2A or 5, as part of the work package.
- If the test results are not within acceptable range, DO NOT start printing or saving the test results. Proceed to Step 7.5.8 below.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

7.5 "As-Found" and "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

7.5.6 **TESTING A SNUBBER** (Continued)

7.5.6.3 **Running the Test** (Continued)

8. ***Saving the Test Results***

To save a test file to disk, click the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv
Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID** for initial drag tests, **AC** for activation tests and **FD** for final drag tests.

Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

9. ***Running Another Test***
Click on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.
- REPEAT the procedure from Step 7.5.6.3.2. to complete Running Another Test.

10. ***Testing Another Snubber***
Select a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.
- REPEAT this procedure from Step 7.5.6.3.1. to complete Testing Another Snubber.

7.5.6.4 **Quitting and Shutting Down the System**
Turn off the 480Vac power on the HPU. On the computer screen, Select EXIT from the File Menu.
When the Windows95 screen appears, Click on START, then SHUTDOWN, and click on Shut down the Computer. Then click OK. When the computer has completely shutdown, turn off the main power switch on the current control consoles.

Reminder: Do not shutdown the console power without exiting Windows properly.

7.5 "As-Found" and "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

NOTE:
At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will not have to be warmed up to perform another test (i.e., the "As-Left" test). Prior to SAVING of the Printed Test Results, determine the following:

7.5.7 If the test results are within the acceptable range, then PREPARE the snubber for reinstallation.

7.5.8 If a snubber fails to meet the functional test acceptance criteria, PERFORM the following:

- NOTIFY the Snubber Engineer/SE Designee immediately for determination of further actions.
- For an as-found test request a Case Specific Acceptance Criteria evaluation using Attachment 6, prior to selecting an expanded sample.
- For an as-found test request a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.
- SELECT a subsequent test lot in accordance with Steps 7.5.9 through 7.5.17, if required.

7.5.9 DETERMINE the subsequent test lot (sample plan), as required.

7.5.10 SELECT the number of restraints equal to 10 percent of the remaining restraints in that subgroup.

7.5.11 SELECT snubbers, as required, by the failure analysis.

7.5.12 SELECT the restraints with the most time from the previous test.

7.5.13 SELECT snubbers that must be tested per an engineering evaluation, if applicable.

7.5.14 DO NOT SELECT snubbers which failed during the last surveillance test.

7.5.15 FILL OUT the applicable sections of Attachment 2A or 5, as required.

7.5.16 SELECT snubbers that failed during the last surveillance test due to location and failed again during subsequent surveillance test.

7.5.17 ENSURE test data package is ready for Shift Manager/Unit Supervisor authorization.

7.6 **Results Evaluation**

NOTE:
The following reviews are usually performed by the Snubber Engineer/SE-Designee, or a representative of Site Engineering Civil:

7.6.1 COMPARE the "As-Found" drag force values to the maximum allowable load from Table 6.2-1 or Table 6.2-2. If the As-Found force exceeds the allowable load, perform a case specific evaluation on Attachment 6.

7.6.2 REVIEW all of the test data on Attachment 2, 2A, or 5, as applicable.

7.6.3 If any snubber is determined to not meet the acceptance criteria:

- NOTIFY the Shift Manager/Unit Supervisor of the inoperable snubber.
- INITIATE a PER in accordance with SPP-8.1 and SPP-3.1.
- INITIATE a Work Order (WO) to replace the snubber, if necessary.
- Perform the supported system or component evaluation on Attachment 4, if required.
- PERFORM a failure evaluation of any inoperable snubber(s) and DOCUMENT on Attachment 3.
- SELECT subsequent test lots (sample plans) in accordance with the applicable section.

7.7 **Data Sheet Review**

7.7.1 ENSURE the WO to remove and reinstall the new snubber has been initiated, as necessary and ENTER the WO number in the remarks section of Attachment 2 or 2A.

7.7.2 ENSURE that all applicable Sections of Attachments are completed for the snubber(s) tested, including sections not required are marked N/A.

7.7.3 ENSURE the Case Specific Acceptance Criteria, Attachment 6, has been prepared, as applicable.

7.7.4 ENSURE the failure analysis of any failed snubber(s) has been performed in accordance with Attachment 3 (disassembly may be necessary).

7.7.5 REVIEW the Site Engineering (Civil) evaluation of the supported component or system analysis Attachment 4, if applicable.

7.7.6 ENSURE the Snubber Engineer has reviewed all of the necessary attachments and all acceptance criteria have been met.

7.7.7 REVIEW the completed SI package for final acceptance.

7.7 **Data Sheet Review** (Continued)

NOTE:
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuild, etc., should be submitted with the SI data package.

7.7.8 SUBMIT the completed package for closure.

8.0 ILLUSTRATIONS/ATTACHMENTS

Appendix A - Subgrouping and Service Life Monitoring of Mechanical Snubbers
Appendix B - Daily Startup Procedures For The STB-200 Test Bench
Appendix C - PSA Mechanical Snubber Rated Load
Appendix D - Common Modes of Snubber Failure and Possible Causes
Appendix E - Instructions For Exchanging the End Plug From Old to New Snubber

Attachment 1 - Surveillance Instruction Review Form
Attachment 2 - Snubber Test Data Using Push-Pull Force Gauges
Attachment 2A- Snubber Test Data Using STB-200 Test Bench
Attachment 3 - Engineering Failure Analysis for Snubber Declared Inoperable
Attachment 4 - Supported Component or System Analysis for Snubber Drag Force Greater than the Maximum Acceptable
Attachment 5 - Test Data for New, Replacement or Rebuilt Snubber Using STB-200 Test Bench
Attachment 6 - Case Specific Acceptance Criteria
Attachment 7 - Evaluation of Loose or Missing Attachment Fasteners

END OF TEXT

APPENDIX A
(Page 1 of 3)

SUBGROUPING AND SERVICE LIFE MONITORING OF MECHANICAL SNUBBERS

1.0 SUBGROUPINGS
For functional testing, mechanical snubbers are divided into three subgroups as described below:

1.1 Subgroups 3a and 3b
These subgroups are based on design features and are composed of medium mechanical snubbers as designed and manufactured by Pacific Scientific Company. They range in capacity from 1500 pounds to 15,000 pounds and are designated as PSA-1, PSA-3, and PSA-10. The design features that set the PSA-1, PSA-3 and PSA-10 mechanical snubbers apart from the small and large mechanical snubbers are the use of a ball screw with a traveling nut that is prevented from rotating by keys traveling in slots. This arrangement is used to transform stroking motion of the snubber into rotation of the inertial mass. These snubbers are divided into subgroups 3a and 3b.

Subgroup 3a
NF design - These snubbers were designed and manufactured in accordance with subsection NF of Section III of the ASME Boiler and Pressure Vessel Code. Materials used for manufacture of the snubber components meet the subsection NF code requirements.

Subgroup 3b
pre-NF design - These snubbers were designed and manufactured to good commercial practice, not to the subsection NF code requirements. Materials used for some of the snubber components do not meet the subsection NF code requirements. Previous functional testing shows that these snubbers have a higher than average failure rate.

1.2 Subgroup 4
This subgroup is based on the design features and is composed of Pacific Scientific Company small mechanical snubbers ranging in capacity from 350 pounds to 650 pounds and are designated as PSA-1/4 and PSA-1/2. The design features that set them apart from the other PSA mechanical snubbers are the use of a coarse lead screw and brass nut to transform stroking of the snubber into rotation of the inertial mass. The brass nut has two slots engaged with two small diameter steel rods that prevent rotation of the nut, but permit the nut to travel along the rods as the snubber is stroked. The rods can be bent during sudden overload of the snubber or by rotating the ends of the snubber during installation when the pins in the front end attachment or pipe clamp and the base plate clevis are not in proper alignment.

1.3 Subgroup 6
This subgroup is based on design features and is composed of large mechanical snubbers as designed and manufactured by Pacific Scientific Company. They range in capacity from 50,000 pounds to 120,000 pounds and are designated as PSA-35 and PSA-100. The PSA-35 and PSA-100 snubbers are equipped with planetary gearing which is not used in the other sizes. As stated above this arrangement is used to transform stroking motion of the snubber into rotation of the inertial mass.

1.4 When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do not fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required. Table B-1 of this SI must be revised when the subgroups change.

APPENDIX A
(Page 2 of 3)

SUBGROUPING AND SERVICE LIFE MONITORING OF MECHANICAL SNUBBERS

1.5 Snubbers tested from severe service areas will remain a part of their respective design subgroup, unless a failure analysis is performed and a separate subgroup is justified and incorporated into this SI.

1.6 Severe service areas include inside the drywell and in the main steam valve vault room. There have been minimal failures of snubbers in these locations, therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

APPENDIX A
(Page 3 of 3)
SUBGROUPING AND SERVICE LIFE MONITORING OF MECHANICAL SNUBBERS

2.0 SERVICE LIFE PROGRAM FOR MECHANICAL SNUBBERS

If the drag force for PSA-1, -3, -10, -35 and -100 mechanical snubber, is at least 3 percent of the rated load, and the drag force increased at least 50 percent above the value measured during the last functional test, the snubber should be evaluated for an impending failure. For PSA-1/4 and -1/2, the snubber should be evaluated for an impending failure if the drag force increased by at least 25 pounds.

Other snubbers may be included in the service life monitoring program if the drag forces are between 4 and 5 percent of the rated load, or snubbers in high temperature or high vibration, and others in harsh environments. The program should include the identification of these snubbers, the schedule for the next evaluation of the snubber, and the documentation of the evaluation of the snubber. The evaluation will usually include review of the drag force changes and determination of the need for future monitoring of the snubber or location.

TABLE B-1
SUBGROUPING OF SNUBBERS

Category Number	Subgroup Number(1)	Description	Quantity Unit 1 (later)	Quantity Unit 2	Quantity Unit 3
1*	4	Small PSA snubbers (PSA-1/4 and -1/2)		2	4
2*	3a	Medium PSA Snubbers (PSA-1,-3,-10);NF		20	17
2*	3b	Medium PSA Snubbers (PSA-1,-3,-10);pre-NF		0	0
2*	6	Large PSA Snubbers (PSA-35,-100)		24	21
10**	4	Small PSA Snubbers (PSA-1/4 and -1/2)		11	3
11**	3a	Medium PSA Snubbers (PSA-1,-3,-10);NF		61	80
11**	3b	Medium PSA Snubbers (PSA-1,-3,-10);pre-NF		20	26
11**	6	Large PSA Snubbers (PSA-35 and -100)		16	43

* These categories are accessible at any time during power operation for the purpose of functional testing.

** These categories are only accessible during an outage, when the reactor is in the cold shutdown mode or in the hot shutdown mode with special provisions from operations and Industrial Safety.

1. The subgroups are listed based on the design features and according to the manufacturer.

Total Mechanical Snubbers in:

	Unit 1 (later)	Unit 2	Unit 3
Small -		13	7
Medium -		101	123
Large -		40	64

APPENDIX B
(Page 1 of 2)

DAILY STARTUP PROCEDURES FOR THE STB-200 TEST BENCH

1. DAILY STARTUP PROCEDURE

1.1 WARM-UP

Exercise both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu.
Clicking on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, Click on the bench label.

1.2 CHECK THE PRESSURE TRANSMITTER

NOTE: This instrument does not provide safety-related data. This check is optional.

In the Manual Control Panel mode, SELECT Manual in the Operating Mode block. Turn the "HP Pump" on, Then use the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi.
Check the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

1.3 PARK THE RAM

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

1.4 SHUT DOWN THE MANUAL CONTROL PANEL

Click on "Shut Down" to exit the Manual Control Panel.

2. STATUS CHECK

2.1 During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and or the jog/drag valve.

2.2 The system should be checked for loose fittings, bolts, etc.

2.3 The filter indicators should be watched during cylinder stroking to insure that they are not illuminating.

2.4 If the indicators are illuminating, the filters should be changed before continuing with operation of the machine or any testing.

APPENDIX B
(Page 2 of 2)

DAILY STARTUP PROCEDURES FOR THE STB-200 TEST BENCH

3. DAILY CALIBRATION CHECKS

The following calibration checks assure the functionality of the instrument and the Data Acquisition and Control System (DAS) for testing. They do not take the place of full system calibrations that must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up to 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

3.1 SELECT THE DAILY CALIBRATION FUNCTION

SELECT the Daily Calibration Check function from the "Tools" menu.

3.2 CONNECT THE LOW RANGE LOAD CELL AS DIRECTED

If directed to by the software, electrically connect the Low Range Load Cell as instructed. The load cell does not need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

3.3 STORE THE "ZERO" CALIBRATION READINGS

For each instrument click the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.4 STORE THE "SPAN" CALIBRATION READINGS

For each instrument, press in the "CAL" button on the front of the instrument, then click the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.5 PRINT THE REPORT

When all readings for both benches have been stored, click on the PRINT button to print the Daily Calibration Report. If the report is "SATISFACTORY", continue the testing. If the report is "UNSATISFACTORY", halt and correct the problem before continuing.

APPENDIX C
(Page 1 of 1)

PSA MECHANICAL SNUBBER RATED LOAD

NOTE:

(NF) identifies the later model PSA mechanical snubbers that were designed to ASME, B&PV Code, Section III, Subsection NF.

Model	Rated Load (lbs.)	Stroke Length (in.)
PSA-1/4 (NF)	350	4
PSA-1/2 (NF)	650	2-1/2
PSA-1 (NF)	1500	4
PSA-3 (NF)	6000	5
PSA-10 (NF)	15000	6
PSA-10	10000	6
PSA-35 (NF)	50000	6
PSA-100 (NF)	120000	6

APPENDIX D
(Page 1 of 1)

COMMON MODES OF SNUBBER FAILURE
AND POSSIBLE CAUSES

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSES
Mechanical	Locked in place	Damaged Thrust Bearing Bent Lead Screw Bent Guides Internal Parts Damaged Due To Wear In Service
	High Drag	Internal Parts Damaged Due To Wear In Service Improper Internal Lubrication
	Does Not Activate	Broken Capstan Spring Internal Parts Damaged Due To Wear In Service
	Damage to Snubber Hardware	Improper Reassembly Improper Installation Improper Handling or Abuse Misapplication Overload Vibration or Wear

APPENDIX E

INSTRUCTIONS FOR EXCHANGING THE END PLUG FROM OLD TO NEW SNUBBER

These instructions are to be followed at any time the end plug is required to be removed from one snubber and placed on a different snubber.

This will most likely take place when a PRE-NF (white) PSA-10 snubber is replaced with a new NF PSA-10 snubber. All of these snubbers are found on the MSRV Tailpipes in all 3 drywells.

When one of these snubbers fails it is to be replaced with a new PSA-10 snubber and the end plug and rear bracket are required to be transferred to the new snubber. This is required because the pin size of the existing snubber is 7/8 inch and the new snubber is 1 inch diameter.

The following instructions are to be followed when exchanging the end plug.

1. REMOVE the filister head screws and flat washers to free the position indicator tube from the end plug assembly of the old and the new snubber.
2. If the screws are distorted or damaged discard and replace.
3. REMOVE the position indicator tube.
4. PLACE the snubber on a work bench or stand.
5. Using an appropriate Allen Wrench, REMOVE the set screws from the end plug assembly.
6. If the screws are distorted or damaged discard and replace.
7. After removing the set screws, USE a size No. 30 drill for a PSA-1 and size No. 23 for a PSA-10, to remove the distorted threads of the telescoping cylinder caused by the set screws.
8. DRILL only to the depth necessary to remove the distortions so the end plug assembly can rotate freely.
9. USE eye protection, and REMOVE any loose drill shavings with clean compressed air.
10. REMOVE the end plugs from the snubbers and exchange them as required.
11. INSTALL the set screws and tighten to distort the threads on the telescoping cylinder.
12. REINSTALL the position indicator tube over the end plug assembly and REINSTALL the filister head screws.

ATTACHMENT 1
(Page 1 of 1)

SURVEILLANCE INSTRUCTION REVIEW FORM

DATE/TIME STARTED ____________ DATE/TIME COMPLETED __________

REASON FOR TEST:
____ Scheduled Surveillance
____ System Inoperable (Explain in Remarks)
____ Maintenance (WO# _______________)
____ Other (Explain in Remarks)

PLANT MODE 1 2 3 4 5 (Circle Appropriate MODE)
MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING MODE 5-REFUELING

PRE-TEST REMARKS: ____
____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)
________	____________________	____________________
________	____________________	____________________
________	____________________	____________________
________	____________________	____________________

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is not Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted ___________Date ______Time

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored _________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted ___________ Date ______ Time ______

==
SECTION REVIEWER (MM) - ______________________________ Date _______________
==

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with the instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/
SITE CIVIL ENGINEERING REVIEWER - ________________________ Date__________
==
SCHEDULING COORDINATOR - ______________________________ Date __________
==

POST-TEST REMARKS: ________________________________ FREQ -Ref. Master Schedule
____FREQ IN RO - .
____KEY - 2395A

ATTACHMENT 2
(Page 1 of 3)
SNUBBER TEST DATA USING PUSH-PULL FORCE GAUGES

WO No. ________________ Unit __ Snubber UNID No. _________________ Sys. No. ____

Serial No. ____________ Subgroup _______ Initial Test Lot _____ Subsequent ____

Exam No. _______ Size ______ Rated Load ________ Lbs. Pipe Size ________

Design drawing number ___________________

Shift Manager/Unit Supervisor and Snubber Engineer notified prior to removal of snubber for functional testing.

______________________	________________	_____________
Foreman/Designee	Date	Time

As-Found Stroke Setting _______

Required Stroke Setting _______
(from Design drawing)

Pipe Temp.: _________ ^{o}F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.

Pyrometer No.: _____________ Calibration Due Date: _________

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

______ Yes _______ No ____________________/_______(AC)
Performer Signature Date

All fasteners for the As-Found snubber(s) are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer is "No", complete Attachment 7.

______ Yes _______ No ____________________/_______(AC)
Performer Signature Date

Force Gauge Number: #1____________ ; #2____________
Calibration Due Date: #1____________ ; #2____________

ATTACHMENT 2

(Page 2 of 3)

SNUBBER TEST DATA USING PUSH-PULL FORCE GAUGES

WO No. __________________ Unit ___ Snubber UNID No. ____________________ Sys. No. _____

BREAKAWAY/DRAG FORCE (lbs)			
TENSION		COMPRESSION	
#1 GAUGE	#2 GAUGE	#1 GAUGE	#2 GAUGE
1	1	1	1
2	2	2	2
3	3	3	3
Avg.	Avg.	Avg.	Avg.

Snubber Test Data: Record maximum acceptable drag force from Table 6.2-1 _______ Lbs.
Record maximum acceptable drag force from Table 6.2-2 _______ Lbs.

Snubber Stroked Full Length ____ Yes ____ No (If No, explain in remarks)

As-Found Final Test Results:
Drag Force (lbs.): _________ Tension _________ Compression

The As-Found final drag force in tension and compression meets acceptance criteria based on the allowable load from Table 6.2-1, Table 6.2-2, or Attachment 6.

_______ Yes _______ No ______________________/_______(AC)

Performer Signature Date

Activation takes place in both tension and compression.

_______ Yes _______ No ______________________/_______(AC)

Performer Signature Date

Maintenance reviewer has reviewed the test data to determine whether the snubber meets all of the functional test acceptance criteria. Maintenance reviewer may be the performer of the test or an independent reviewer.

Acceptance criteria satisfied _______ Yes _______ No

________________________/_______

Maintenance Reviewer Date

The Snubber Engineer/SE Designee has performed a second party review of the test data to verify that the snubber meets all of the functional test acceptance criteria. If the response is No (the snubber has not satisfied the acceptance criteria), specify in remarks actions to be taken:

Acceptance criteria satisfied _______ Yes _______ No

Remarks:____

____

____

____/_________

SITE ENGINEERING (SNUBBER ENGINEER/SE DESIGNEE) REVIEW DATE

ATTACHMENT 2
(Page 3 of 3)

SNUBBER TEST DATA USING PUSH-PULL FORCE GAUGES

WO No. ________________ Unit __ Snubber UNID No. _________________ Sys. No. ____

Snubber reinstallation:

Same snubber reinstalled If No, enter serial number (N/A if same snubber is reinstalled) and include Attachment 5	___Yes ___No Serial Number _________
Snubber is reinstalled in proper location	___Yes ___No ___N/A
Snubber is reinstalled with base of housing up (for vertical snubbers)	___Yes ___No ___N/A
All locking devices are secured	___Yes ___No ___N/A
Cotter pins are spread	___Yes ___No ___N/A
Spherical bearing greased	___Yes ___No ___N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___Yes ___No ___N/A
Snubber is tagged	___Yes ___No ___N/A
Bolts and jam nuts torqued	___Yes ___No ___N/A
Anti-seize compound applied, as needed	___Yes ___No ___N/A

Torque Wrench No. __________
Calibration Due Date _______

As-Left Stroke Setting _____

______________________/_________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the Design Drawing.

_______ Yes _______ No

______________________/_________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

_________________/_________
Foreman/Designee Date

Remarks: ____

____

ATTACHMENT 2A
(Page 1 of 3)

TEST DATA FOR REMOVED AND REINSTALLED SNUBBER
USING THE STB-200 TEST BENCH

NOTE:
This Data Sheet is to be used to document removed and reinstalled snubber functional test data and shall be attached to the Work Order as appropriate.

WO No. ________________ Unit __ Snubber UNID No. ________________ System. No. ____

Serial No. ________ Subgroup ______ Initial Test Lot ____ Subsequent _____

Exam No. _____ Size ______ Rated Load _______ Pipe Size ______

Design drawing number ______________

Shift Manager/Unit Supervisor/Snubber Engineer notified prior to removal of snubber for functional testing.

Foreman/Designee	Date	Time

As-Found Stroke Setting _______

Required Stroke Setting _______
(from Design drawing)

Pipe Temp.: _____^{O}F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.

Pyrometer No.: ____________ Calibration Due Date: _________

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

______ Yes _______ No ____________________/______(AC)
Performer Signature Date

All fasteners in the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer is "No", complete Attachment 7.

______ Yes _______ No ____________________/______(AC)
Performer Signature Date

ATTACHMENT 2A
(Page 2 of 3)
TEST DATA FOR REMOVED AND REINSTALLED SNUBBER
USING THE STB-200 TEST BENCH

WO No. ________________ Unit __ Snubber UNID No. _______________ System. No. ____

Snubber Test Data: Record maximum acceptable drag force from Table 6.2-1 _____ lbs.
Record maximum acceptable drag force from Table 6.2-2 _____ lbs.

Snubber Stroked Full Length ___ Yes ___ No (If No, explain in remarks)

As-Found Final Test results:
Peak Final Drag Forces (lbs.): ___________ Tension __________ Compression

The As-Found final drag force in tension and compression meets acceptance criteria based on the allowable load from Table 6.2-1, Table 6.2-2, or Attachment 6.

______ Yes ______ No ______________________/_______ (AC)
Performer Signature Date

Activation takes place in both tension and compression.

______ Yes ______ No ______________________/_______ (AC)
Performer Signature Date

Maintenance reviewer has reviewed the test data to determine whether the snubber meets all of the functional test acceptance criteria. Maintenance reviewer may be the performer of the test or an independent reviewer.

Acceptance criteria satisfied ______ Yes ______ No

______________________/______ (AC)
Maintenance Reviewer Date

The Snubber Engineer/SE Designee has performed a second party review of the test data to verify that the snubber meets all of the functional test acceptance criteria. If the response is No (the snubber has not satisfied the acceptance criteria), specify in remarks actions to be taken:

Acceptance criteria satisfied ______ Yes ______ No

Remarks:____
____
____
____

____/________
SITE ENGINEERING (SNUBBER ENGINEER/SE DESIGNEE) REVIEW Date

ATTACHMENT 2A
(Page 3 of 3)
TEST DATA FOR REMOVED AND REINSTALLED SNUBBER
USING THE STB-200 TEST BENCH

WO No. ________________ Unit __ Snubber UNID No. _______________ System No. ____

Snubber reinstallation:

Same snubber reinstalled If No, enter serial number (N/A if same snubber is reinstalled) and include Attachment 5	___Yes ___No ___N/A Serial Number __________
Snubber is reinstalled in proper location	___Yes ___No ___N/A
Snubber is reinstalled with base of housing up (for vertical snubbers)	___Yes ___No ___N/A
All locking devices are secured	___Yes ___No ___N/A
Cotter pins are spread	___Yes ___No ___N/A
Spherical bearing greased	___Yes ___No ___N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___Yes ___No ___N/A
Snubber is tagged	___Yes ___No ___N/A
Bolts and jam nuts torqued	___Yes ___No ___N/A
Anti-seize compound applied, as needed	___Yes ___No ___N/A

Torque Wrench No. __________
Calibration Due Date _______
As-Left Stroke Setting _____

______________________/_______
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the Design Drawing as verified.

_______ Yes _______ No

______________________/_______
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

____________________/_______
Foreman/Designee Date

Remarks:____

____

ATTACHMENT 3
(Page 1 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. ________________

Subgroup No. ______ PER No. _____________________ Mfg./Size _________________________

Serial No. _______ Rated Load ___________ Exam No. ______

1. Describe the mode of failure(s), as discussed on Appendix D.

☐ Locked up ☐ High Drag Force ☐ Snubber would not activate
☐ Damage to snubber hardware

Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix D for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release, or locked up, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No
If yes, contact the Maintenance Snubber Engineer/Designee for further actions to be taken.
Explain Evaluation:

ATTACHMENT 3
(Page 2 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. ________________

5. Snubber Failure is classified as: ☐ Isolated ☐ Location
☐ Manufacturing ☐ Design ☐ Unknown ☐ Other

Describe the basis for the classification:

6. <u>For Subgrouping Purposes Only</u> - Evaluation of subgroup composition (new type snubber, changing subgroup of existing snubber, etc.)

7. Does the vendor need to be contacted? ☐ Yes ☐ No
Vendor Name:
Person contacted: Date:
Vendor's Comments:

8. What subsequent testing is required because of this failure?

Subsequent Lot No. No. of snubbers to be tested

9. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ________________________________/_________
Snubber Engineer/SE Designee Date

ATTACHMENT 4
(Page 1 of 1)

SUPPORTED SYSTEM/COMPONENT ANALYSIS FOR SNUBBER DRAG FORCE GREATER THAN THE MAXIMUM ACCEPTABLE DRAG FORCE

WO No. ______________ Unit _ Snubber UNID No. ________________

Subgroup No. _____ PER No. _____________________ Mfg./Size ________________________

Serial No. ______ Rated Load __________ Exam No. _____

1. Describe the condition(s) (Whether the snubber would not activate, was the snubber locked up, or excessive drag force, etc.)

2. Attach the SE Evaluation of the attached component:

3. Describe the corrective action to be taken (repair, replacement, additional testing, future testing, service life monitoring, etc., for evaluation of subgroup composition, etc. Use additional sheets as necessary):

________________________________/________
Snubber Engineer/SE Designee Date

ATTACHMENT 5

(Page 1 of 1)

TEST DATA FOR NEW, REPLACEMENT, OR REBUILT SNUBBER
USING THE STB-200 TEST BENCH

NOTE:
This Data Sheet is to be used only to document test bench functional test data of new, replacement or rebuilt snubbers and shall be attached to the Work Order, as appropriate.

WO No. ____________________ Unit __ Snubber UNID No. ________________________

Serial No. _____________ Size ___________ Rated Load ___________ Exam No. _____

Snubber Test Data: Record maximum acceptable drag force from Table 6.2-1 ______ Lbs.

As-Left Test results:
Peak Final Drag Forces(lbs): ___________Tension ____________Compression

The As-Left drag force of the snubber does not exceed the allowable load from Table 6.2-1

______ Yes ______ No ______________________/______(AC)

Performer Signature Date

Activation takes place in both tension and compression

______ Yes ______ No ______________________/______(AC)

Performer Signature Date

Snubber Stroked Full Length ___ Yes ___ No

Snubber meets acceptance criteria ___ Yes ___ No

______________________/______

Performer Signature Date

Review test data for acceptability. If the test results are unacceptable, do not install snubber in any piping system, component, or feature in the plant.

____

____

____

____________________________/______

Snubber Engineer/SE Designee Date

ATTACHMENT 6
(Page 1 of 1)

CASE SPECIFIC ACCEPTANCE CRITERIA

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ Mfg./Size __________________________

Serial No. ________ Rated Load __________ Exam No. _____

1. Describe the standard acceptance criteria:

☐ As-Found ☐ As-Left

2. Record the parameter (i.e., activation, bleed, drag) and the test results that are outside the standard acceptance criteria:

☐ As-Found ☐ As-Left

3. Test results for parameters listed in item 2 are acceptable for case specific acceptance criteria:

☐ Yes ☐ No

4. If evaluation is for As-Found acceptance criteria, is functional testing of an additional lot in accordance with Steps 7.5.9 through 7.5.17 required:

☐ Yes ☐ No

Justification for determination (items 3 and 4):

_________________________/_________

Site Engineering Civil Date

ATTACHMENT 7
(Page 1 of 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners, used for attachment of the snubber to component and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing.

WO No. ______________________ Unit __ Date Discovered __________

UNID No. ______________________ Serial No. ___________ Size __________ Subgroup ______

Location ______________________ Tag No. ______

1, Describe the discovered condition(s): ____
____
____

2. If possible, determine cause: ____
____
____
____
____

Evaluated by: _______________ / Date _____

3. Evaluate to determine whether the cause may be localized or generic.
Use this evaluation to select and list other suspect snubber for verifying attachment fasteners, as applicable.
____
____
____
____
____

Evaluated by: ______________ Date: ________

4. Describe the corrective actions (s) and provide the As-Found test results .__________________________
____
____
____
____
____
____

Entered by: ______________ Date: ________

Attachment D

BFN SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2B,

Functional Testing of Bergen-Paterson, Anchor/Darling, or Fronek Hydraulic Snubbers

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2B

FUNCTIONAL TESTING OF BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBERS

REVISION 5

PREPARED BY: B. M. PEDROSO JR. PHONE: 3177

RESPONSIBLE ORGANIZATION: SITE ENGINEERING (CIVIL)

APPROVED BY: ERIC FREVOLD DATE: 05/02/2005

EFFECTIVE DATE: 05/05/2005

LEVEL OF USE: CONTINUOUS USE

QUALITY-RELATED

REVISION LOG

Procedure Number: 0-SI-4.6.H-2B Revision Number: 5

Pages Affected: Cover Sheet, Revision Log, 1 to 19, 30, 34, 35, and 39 to 48.

Description of Change: IC-06

This procedure is being revised to clearly define the As-Found and As-Left acceptance criteria in Section 6.0; updated Appendix G to reflect changes due to U2C13 in the seal service life of Bergen Paterson hydraulic snubbers; added instruction note on Attachment 1; revised Attachment 2 to provide snubber operability checks, performer sign-off, and deleted second party sign-off; clarified sections in the body of the procedure, and corrected minor typographical error.

TABLE OF CONTENTS

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing of Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers, as given in the Snubber Program Procedure (0-TI-398), on all safety related systems, inside and outside of the drywell.

1.2 Scope

NOTES:

(1) For the purposes of this instruction, the snubbers are categorized into two major groups, based on whether the snubbers are accessible or inaccessible during reactor operation. These major groups may further be divided into subgroups based on design of the snubbers or may be established by engineering analysis based on environment or other failures which may be expected to affect the operability of the snubbers within the group.

(2) The terms group or category may be used interchangeably throughout this instruction.

(3) The remaining portions of Technical Requirements TR 3.7.4 pertains to the visual examination of snubbers and is implemented by Surveillance Instructions 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

1.2.1 Guidance to Perform the Functional Test

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers addressed as HSSA-3, -10, -20, -30, ADH-20, -30, -50, -70 and -130 for Units 1, 2, and 3 as follows:

- Removal and reinstallation of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 1 and 2.

- Provides the requirements for functional testing and service life monitoring of Bergen-Paterson, Anchor/Darling or Fronek hydraulic snubbers. This instruction covers subgroup 1 only (see Appendix B for snubber subgroup information). To completely fulfill the snubber Technical Requirements Manual (TRM) functional testing requirements, Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D, and 0-SI-4.6.H-2E must also be performed.

- Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.

- This Surveillance Instruction shall be used to verify operability of hydraulic snubbers suspected inoperable during performance of the visual examination SI's.

1.3 Frequency/Conditions

1.3.1 This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 1-SI-4.6.H-1, 2-SI-4.6.H-1, and 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.

1.3.2 This instruction may be performed at any time for snubbers outside the drywell, but may only be performed during an outage for snubbers inside the drywell.

1.3.3 All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

1.3.4 Snubbers located inside the drywell on reactor vessel attached piping shall be OPERABLE whenever fuel is in the reactor vessel. Snubbers on the Main Steam, HPCI, and RCIC piping in the drywell are exempt from the operability requirement when the steam line plugs are installed in the reactor vessel.

1.3.5 Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

1.3.6 A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate action statement for that system.

1.3.7 For an inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does not meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM.
The engineering evaluation is to determine if components or system restrained by the snubber(s) were adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

1.3.8 Alternately, for a snubber removed and not replaced within 72 hours, or an inoperable snubber not replaced or restored within 72 hours, operability of the supported system may be verified based on an engineering evaluation of the system functional capability with the removed or inoperable snubber.

1.3.9 Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004, and tested in accordance with this instruction prior to declaring the system operable.

1.3 Frequency/Conditions (Continued)

1.3.10 For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found, or all snubbers in that subgroup have been tested, or all suspect snubbers identified by the failure analysis have been tested, as applicable. The failure analysis shall be used, as applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of the snubbers which may also be subject to the same failure mode.

1.3.11 New, replaced or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

2.1 Technical Requirements Manual, TR 3.7.4, Snubbers.

2.2 1-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.3 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.4 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.5 MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling and Fronek Unit Disassembly and Reassembly

2.6 MPI-0-000-SNB004, Instructions for Removing and Installing Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

2.7 BFN-VTM-B209-0230, Vendor Technical Manual for Bergen-Paterson Hydraulic Shock and Sway Arrestors.

2.8 0-TI-398, Snubber Program Procedure

2.9 SPP-3.1, Corrective Action Program

2.10 SPP-8.1, Conduct of Testing.

2.11 CDQ0-999-2002-0772, Evaluation for Seal Service Life Extension for Bergen Paterson, Anchor/Darling or Fronek Hydraulic Snubbers.

3.0 PRECAUTIONS AND LIMITATIONS

NONE

4.0 PREREQUISITES

4.1 Six months prior to each refueling outage, the supply of hydraulic snubbers in the Snubber Rebuild Facility shall be reviewed and a minimum of 10% of each size being tested shall be rebuilt and ensure the proper paperwork is with them to comply with the requirements of the Section XI Repair and Replacement Program. This paperwork shall include the purchase contract and Certificate of Compliance for the material.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

NONE

6.0 ACCEPTANCE CRITERIA

6.1 Responses which fail to meet the following acceptance criteria require immediate notification of the Snubber Engineer/SE Designee at the time of failure.

6.2 The snubber functional test shall verify that:

6.2.1 "As-Found"

- Corrected activation shall occur in both directions of travel at a piston velocity greater than or equal 1 inches/minute and less than or equal 30 inches/minute.

NOTE:
For As-Found testing the only requirement for the bleed rate is that there is bleed after the snubber activates.

- Corrected bleed shall take place after activation of the snubber in both the tension and compression.
- Drag forces greater than 2.0 percent of the snubber rated load will require Site Engineering review/evaluation.
- Activation, bleed, or drag force acceptance criteria may be other than that described in the Steps above, if approved by Site Engineering on Attachment 5.

6.2.2 "As-Left"

- Corrected activation should occur in both directions of travel at a piston velocity greater than or equal 5 inches/minute and less than or equal 20 inches/minute.
- Corrected bleed shall take place after activation of the snubber in both tension and compression and shall be within the ranges shown in Appendix C for each size of snubber.
- Drag force shall be less than 2.0 percent of the snubber rated load.
- Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.3 The stroke setting shall be within the limits shown on the design drawing.

6.4 There shall be no loose or missing fasteners for attachment of the As-Found snubber(s) to the component or the anchorage. Otherwise, complete Attachment 6.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

7.1.1 A thorough briefing should be conducted on SI performance prior to starting.

7.1.2 The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

7.1.3 Appropriate General Employee Training (GET) including respirator training should be completed by test personnel prior to performing this SI.

7.1.4 Training required for the testing of hydraulic snubbers shall meet the requirements of Task Number MMY 510.

7.2 Preparation of Test Data Package

7.2.1 EXCLUDE the snubbers from the initial test lot (sample plan) which are scheduled for deletion, in accordance with approved Design Change Notices.

7.2.2 EXCLUDE the snubbers until the next outage from the initial test lot (sample plan) which are to be added, in accordance with approved Design Change Notices.

7.2.3 SELECT snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

7.2.4 DETERMINE the initial test lot (sample plan) as follows:

- SELECT 10 percent of the snubbers from subgroup 1 (see Appendix B).
- SELECT the snubbers with the most time from the previous test.
- Sample should be weighted to include more snubbers from severe service areas (i.e. inside the drywell).
- SELECT snubbers that have experienced severe transients.
- SELECT snubbers of various sizes.

NOTE:
Snubbers that failed because of location are to be tested separately from the initial test lot (sample plan).

- SELECT snubber(s) that must be tested per an Engineering Evaluation, if applicable.
- DO NOT SELECT snubber(s) which failed during the last surveillance test.

7.2 Preparation of Test Data Package (Continued)

7.2.5 REVIEW the applicable hanger drawings to verify the location and any conditions that will require special preparation or equipment.

7.2.6 REQUEST scaffold or similar devices to be built or available, as necessary.

7.2.7 RECORD the date, time and other required information on Attachment 1, and prior to REMOVAL of a snubber per MPI-0-000-SNB004 for functional test, RECORD the "As-Found" Stroke Setting in Attachment 2.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench

7.3.1 If the extension or one of the end attachments has been removed, INSTALL the appropriate end attachments located in the snubber test facility.

7.3.2 ENSURE the test bench has been warmed up in accordance with Appendix E of this procedure.

NOTE:
The following describes a suggested procedure for "Testing a Snubber" using the STB 200 Snubber Test Bench with the upgraded Windows Software Operations Manual.

7.3.3 **POWERING UP THE TEST SYSTEM**
TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on.
TURN ON the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit.
ENSURE that all emergency stop buttons are pulled out.

7.3.4 **STARTING THE SOFTWARE**
Once the computer has "Booted Up", the Windows Desktop will be displayed. SELECT the "STB 200" icon and double click on it, this will Start the Test program.
The LOG ON prompt window will appear. ENTER you user name and password in either upper or lower case letters. All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

7.3.5 **DAILY CALIBRATION CHECK**
PERFORM the daily calibration check, using Appendix E and sign the daily calibration form.
After the daily calibration check has been completed, and the Daily Calibration Report is "SATISFACTORY", proceed on testing a snubber.

NOTE:
A surface contact pyrometer may be used to obtain the surface temperature of the snubber, and RECORD the temperature correction from Appendix D for the surface temperature obtained, on Attachment 2 as appropriate.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

7.3.6 **TESTING A SNUBBER**

7.3.6.1 **Pick the Snubber Type**
Using the Snubber Pull Down List in the User Supplied Information block, SELECT the Type Snubber to be tested.

7.3.6.2 **Enter the Header Information**
FILL in the other information as indicated in the User Supplied Information block.

7.3.6.3 **Running the Test**

1. ***Pick the Test***
   CLICK on the Type of Test desired (i.e., "As-Found" or "As-Left" as desired).

2. ***Start the Test***
   CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

3. ***Tare weight Window***
   This window allows the User to "zero out" any offset load that the load cell may be reading. This should be performed BEFORE installing the snubber in the test bench.
   Wait for the "Raw Reading" to settle (as far as possible), and then Click "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb.
   The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired.
   Once the readings are as desired, Click the "Continue" button.

   ENSURE the correct load cell is connected to the machine.

   CHOOSE the proper bushings and pins for the snubber being tested, then INSTALL the bushings in both clevis attachments on the machine.

4. ***Stroke and Position Window***
   INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. Adjust the backstop and or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed.

   The joystick on the test frame controls the actual motion of the driver.

   INSTALL the pins through the bushing and the snubber spherical bearings.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

7.3.6 **TESTING A SNUBBER** (Continued)

7.3.6.3 **Running the Test** (Continued)

4. ***Stroke and Position Window*** *(Continued)*

NOTE: Once the snubber has been pinned for the "As-Left" type test ONLY, as selected in Step 7.3.6.3.1, STROKE the snubber in both direction slowly using the Joystick. REPEAT stroking several times as needed, to REFILL and PURGE trapped air in the snubber.

ONCE the snubber has been pinned for a test, the snubber's piston position (distance from the fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated.
The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of stroke (minus a 1/2 inch safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, TIGHTEN the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber UNID number, WO number, system number, serial number, and test equipment information on Attachment 2 as required, and Click on "Continue with Test" to continue the test.

5. ***If an Activation Test is Selected***
After all the above steps have been completed, and PRIOR to starting an "As-Found" Activation Test, the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the setpoint and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will rest to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

7.3.6 **TESTING A SNUBBER** (Continued)

7.3.6.3 **Running the Test** (Continued)

5. ***If an Activation Test is Selected*** *(Continued)*

- OBSERVE that the snubber activates in both directions, to establish operability of the snubber in the "As-Found" condition.

- RECORD all necessary information on Attachment 2, as appropriate.

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

NOTE: Forcing a test may allow the machine to overstress the snubber during the test!.

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

6. ***If Drag Test is Selected***
If a Drag Test (i.e., **ID**, **AC**, and **FD** test sequence for "As-Left", and **AC**, **FD** test sequence for "As-Found" test) is selected, the test system will automatically begin the drag test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke. The Raw Test Data graphed in real time is reviewed to:

- VERIFY that the drag force of the snubber is not greater than 2% of the rated load.

- RECORD this information on Attachment 2, as appropriate.

7. ***Printing the Results***
After the test is complete, the calculations appropriate to that test are performed and the results are displayed on the screen. This allows the user to review and determine if the "As-Found" test results meets the "As-Left" acceptance criteria, and plot the test results:

- If the results are within the "As-Left" acceptance range,

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

7.3.6 **TESTING A SNUBBER** (Continued)

7.3.6.3 **Running the Test** (Continued)

7. ***Printing the Results*** *(Continued)*
Click on the "Print Test" button to open the standard Windows printer dialog box. SELECT the proper printer, and click "OK" to start the printing.

- ATTACH the Printed Results in Attachment 2, as part of the work package.

- If the test results are not within acceptable range, DO NOT start printing or saving the test results. Proceed to Step 7.3.11 below.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

8. ***Saving the Test Results***
To save a test file to disk, click the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv

Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID** for initial drag tests, **AC** for activation tests and **FD** for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

9. ***Running Another Test***
Click on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.

- REPEAT the procedure from Step 7.3.6.3.2. to complete Running Another Test (i.e., the "As-Left"), as needed.

10. ***Testing Another Snubber***
Select a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested,

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

7.3.6 **TESTING A SNUBBER** (Continued)

7.3.6.3 **Running the Test** (Continued)

*10. **Testing Another Snubber*** *(Continued)*
the user has to only change the serial number, hanger number, and work order entries.

- REPEAT this procedure from Step 7.3.6.3.1. to complete Testing Another Snubber.

7.3.6.4 **Quitting and Shutting Down the System**
TURN OFF the 480Vac power on the HPU. On the computer screen, Select EXIT from the File Menu. When the Windows screen appears, Click on START, then SHUTDOWN, and click on Shut down the Computer. Then click OK.

When the computer has completely shutdown, TURN OFF the main power switch on the current control consoles.

Reminder: Do not shutdown the console power without exiting Windows properly.

NOTE:
At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will not have to be warmed up to perform another test (i.e., the "As-Left" test as needed).

7.3.7 DETERMINE if the "As-Found" test results meet the acceptance criteria in Section 6.2.1.

7.3.8 If the test results are within the acceptable range, then ENTER the information on Attachment 2, as appropriate.

7.3.9 If the test results are within the acceptable range, then COMPARE the "As-Found" test results of snubber found acceptable, with the desirable "As-Left" acceptance criteria in Section 6.2.2.

7.3.10 If the test results are within the acceptance criteria, then PREPARE the snubber for reinstallation. If not, then PERFORM the "As-Left" testing in accordance with Section 7.4, as necessary, to obtain the desirable "As-Left" range.

7.3.11 If a snubber fails to meet the functional test acceptance criteria, then PERFORM the following:

- NOTIFY the Snubber Engineer/SE Designee for determination of further actions.
- REQUEST a case specific acceptance criteria evaluation using Attachment 5.

7.3 "As-Found" Functional Test Using the STB-200 Test Bench (Continued)

- REQUEST a failure analysis on Attachment 3, and a supported system or component analysis on Attachment 4, as necessary.

7.3.12 DETERMINE the subsequent test lot (sample plan), as required.

7.3.13 SELECT the number of restraints equal to 10 percent of the remaining restraints in that subgroup.

7.3.14 SELECT the restraints with the most time from the previous test.

7.3.15 SELECT snubbers that must be tested per an engineering evaluation, if applicable.

7.3.16 DO NOT SELECT snubbers which failed during the last surveillance test.

7.3.17 FILL OUT ALL applicable sections of Attachment 2, as required.

7.3.18 ENSURE test data package is ready for Shift Manager/Unit Supervisor authorization.

7.3.19 PERFORM applicable functional test for the subsequent test lot (sample plan).

7.4 "As-Left" Functional Test Using the STB-200 Test Bench

NOTE:

The "As-Left" test must meet the acceptance criteria of Section 6.2.2. However, to ensure the snubber remains within an acceptable range during service, the "As-Left" lock up and bleed rates should fall as close to the center of the range as possible, as determined by the Snubber Engineer/SE Designee.

7.4.1 DETERMINE if the "As-Left" testing is required based on the following:

- If the snubber has been rebuilt, then PERFORM the "As-Left" testing in accordance with this Section.
- If the results of Step 7.3.9 meet the acceptance criteria in Section 6.2.2, but fall outside of the desirable activation velocity or bleed rate range, then PERFORM the "As-Left" testing in accordance with this Section as determined by the Snubber Engineer/SE Designee.
- If the results of Step 7.3.9 do not meet the acceptance criteria in Section 6.2.2, then PERFORM adjustments and the "As-Left" testing in accordance with this Section.

7.4.2 If the test machine has been left on, it will be ready to Run Another Test. CLICK on the type of test (the "As-Left") to be performed. The results of the last test will be erased, and the graph will rescale for the "As-Left" test to be done.

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

REPEAT "Running the Test" procedure for the "As-Left" test starting from Step 7.3.6.3.2.

7.4.3 If the machine has been turned off, then repeat the daily startup procedure, Appendix E and Steps 7.3.1 thru 7.3.6.2.

7.4.4 ENTER the snubber number, WO number, system number, serial number and test equipment information on Attachment 2, as appropriate.

7.4.5 MEASURE the snubber surface temperature with a pyrometer, and RECORD the temperature correction from Appendix D for the measured surface temperature reading on Attachment 2, as appropriate.

7.4.6 REPEAT Steps 7.3.6.3 through 7.3.6.4 to complete the "As-Left" test.
NOTE that the "As-Left" test sequence may start with the Initial Drag test, followed by the Activation test, and the Final Drag test.
The "As-Found" test sequence normally starts with the Activation test, and then the Final Drag test.

7.4.7 As shown in Appendix A, Illustrations A-1 and A-2, fluid from the rod end (extension or "out" direction) activates the poppet in the connector tube end of the valve block. Fluid from the blind end (compression or "in" direction) activates the poppet under the poppet stop and plug.

7.4.8 If the snubber locks up at too low of a velocity, the width between the flats on the poppet head is too great, causing too much resistance to flow and the poppet closes at a low flow rate.

7.4.9 REPLACE the poppet with one which has a smaller distance between the flats Appendix A, Table A-1.

NOTE:
A change of approximately 0.006 inches (0.003 inches each side) in the distance between the flats will change the lock-up velocity approximately one inch per minute.

7.4.10 If poppets are not available with the required dimensions, a small amount of material may be removed by filing/shaving or added by welding and then machined to the needed/finished dimension.

NOTE:
When enough material is to be removed that the squareness and symmetry is likely to be lost, the poppet heads are to be milled, removing the same amount of material from each side of the head.

7.4.11 Material may be added to the poppet head which is too narrow, using weld procedure GE-11-0-1. After welding, the flats are to be milled to the proper dimension.

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

NOTES:

(1) Poppets supplied by Bergen-Paterson, manufactured after August 1977, are identified by an "E" stamped on the head of extension poppets. Compression poppets are not marked. Prior to August 1977, neither extension or compression poppets were marked. Appendix A, Table A-1 lists the current factory dimensions and part numbers for the poppets.

(2) The valve and poppets used for the external pipe configuration snubbers do not have the exact dimensions as the later models, the current model poppets can be adjusted to give the required results in the external pipe configuration.

(3) The bleed rate is determined by the amount of fluid that goes through the grooves in the tapered part of the poppet when it closes on the valve seat.

(4) If the bleed rate is too fast for the amount of force developed, the grooves are too deep.

7.4.12 MACHINE the tapered portion of the poppet at the existing angle just enough to almost clean off the grooves.

NOTE:
A Noburod or Severance chamfering tool may be used to remove the grooves.

7.4.13 ENSURE that the tapered portion of the poppet is machined smoothly and true, since it is a sealing surface.

NOTE:
If too much material is removed, the POPPET will be shortened and the spring will be compressed solid before the poppet reaches the seat.

7.4.14 RESTORE the grooves, as necessary, using a machinist file.

NOTE:
A slight change in the depth of the groove makes a lot of difference in the bleed rate of the snubber.

7.4.15 Each time the valve, cylinder or accumulator are reassembled, REFILL them with silicone fluid and BLEED/PURGE any entrapped air from the passages of the snubber.

NOTE:
Air contained in the fluid changes the lock-up and bleed rate, therefore the fluid should be free of air when the functional tests are performed.

7.4.16 When the bleed rate has been adjusted or replacement poppets have been installed, the complete functional test is to be repeated.

7.4.17 REPEAT Steps 7.3.6.3 thru 7.3.6.4, as necessary, to achieve the lock-up and bleed rates, as required to meet the acceptance criteria stated in Section 6.2.2.

7.4 "As-Left" Functional Test Using the STB-200 Test Bench (Continued)

7.4.18 RECORD the "As-Left" test results on Attachment 2, and indicate " As-Left" test "Passed" on a tag to be wired to the snubber.

7.4.19 The person responsible for performing the functional test shall sign, date the tag, and attach/wire the tag to the snubber.

7.5 Hydraulic Snubber Service Life Monitoring

7.5.1 RECORD the "As-Found" stroke setting in Attachment 2, as appropriate and REMOVE the snubber in accordance with MPI-0-000-SNB004.

7.5.2 PERFORM "As-Found" test on the snubber, as required per Section 7.3.

7.5.3 REBUILD the snubber replacing all seals and fluid in accordance with MPI-0-000-SNB002.

7.5.4 PERFORM "As-Left" test for the snubber in accordance with Section 7.4.

7.5.5 REINSTALL the snubbers in accordance with MPI-0-000-SNB004, and RECORD the "As-Left" Stroke Setting in Attachment 2, as appropriate.

7.5.6 MARK Appendix G to show the month and year the new seals were installed (last seal service date) and serial number.

7.5.7 ADD the seal service life (17 years) to the last seal service date, ENTER on Appendix G the month and year of the next required seal service date.

NOTE:
This instruction is to be revised to incorporate the updated service life information, as marked in Appendix G, after each refueling outage in which the seals were replaced for service life monitoring.

7.5.8 SUBMIT the completed original Attachment 2 to the Snubber Engineer/SE Designee for review and to include in the SI package.

7.6 Results Evaluation

NOTE:
The following reviews are performed by the Snubber Engineer/SE-Designee, or Site Engineering Civil Reviewer.

7.6.1 REVIEW all of the test data on Attachment 2, as applicable.

7.6.2 If any snubber is determined to not meet the acceptance criteria:

- NOTIFY the Shift Manager/Unit Supervisor of the inoperable snubber.
- INITIATE a PER in accordance with SPP-8.1 and SPP-3.1.
- INITIATE a Work Order (WO) to replace the snubber, if necessary.

7.6 Results Evaluation (Continued)

- PERFORM a failure evaluation of any inoperable snubber(s) and DOCUMENT on Attachment 3.
- PERFORM the supported system/component evaluation on Attachment 4.
- SELECT the subsequent test lots (sample plan).

7.7 Data Sheet Review

7.7.1 VERIFY that all applicable Attachments are completed for the snubber(s) tested.

7.7.2 VERIFY the failure analysis of any failed snubber(s) has been performed in accordance with Attachment 3 (disassembly may be necessary).

7.7.3 REVIEW the Site Engineering (Civil) evaluation of the supported component or system analysis Attachment 4, if applicable.

7.7.4 VERIFY the Case Specific Acceptance Criteria, Attachment 5, has been prepared, as applicable.

7.7.5 VERIFY the Snubber Engineer/SE Designee has reviewed all of the necessary attachments and all acceptance criteria have been met.

7.7.6 Review the completed SI package for final acceptance.

NOTE:
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuilds, and etc., should be submitted with the SI data package.

7.7.7 Submit the completed package for closure.

8.0 ILLUSTRATIONS/ATTACHMENTS

Illustration 1 - Piston Rod Position Measurement

Appendix A - Snubber Flow Path, Control Valve Assembly, and Poppet Sizes
Appendix B - Subgrouping and Service Life Monitoring of Snubbers
Appendix C - Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubber Acceptance Criteria
Appendix D - Correction for Temperature
Appendix E - Daily Startup Procedure for the STB-200 Test Bench
Appendix F - Common Modes of Snubber Failure and Possible Causes
Appendix G - Service Life Monitoring for Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubbers

Attachment 1 - Surveillance Instruction Review Form
Attachment 2 - As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Bergen Paterson Hydraulic Snubber
Attachment 3 - Engineering Failure Analysis for Snubber Declared Inoperable

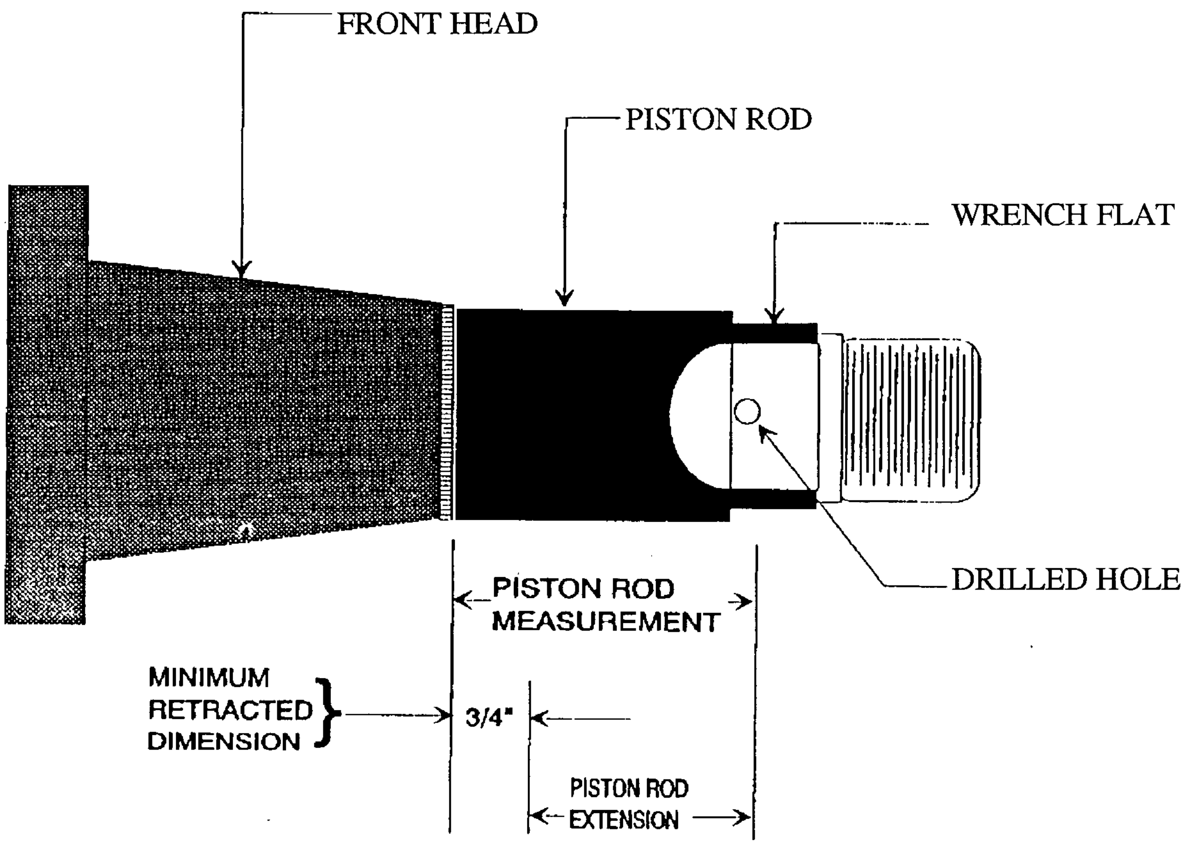
8.0 ILLUSTRATIONS/ATTACHMENTS (Continued)

Attachment 4 - Supported System/Component Analysis for Snubber Declared Inoperable
Attachment 5 - Case Specific Acceptance Criteria
Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners

END OF TEXT

ILLUSTRATION 1
(Page 1 of 1)

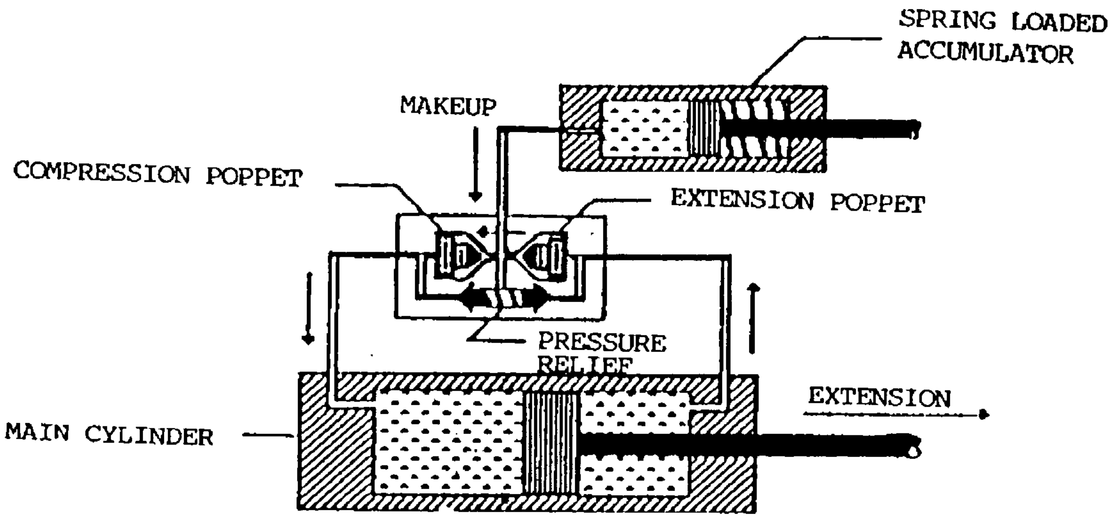
PISTON ROD POSITION MEASUREMENT



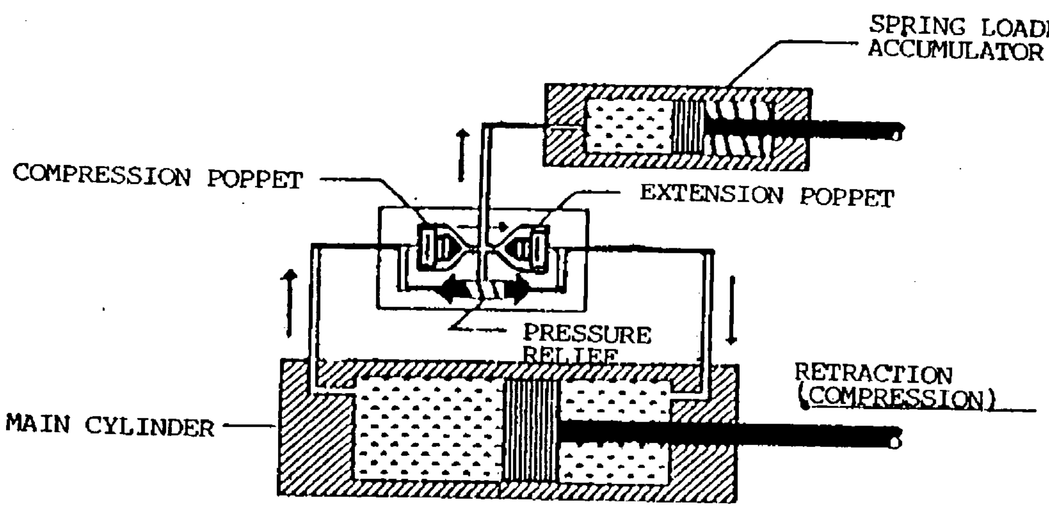
APPENDIX A
(Page 1 of 3)

ILLUSTRATION A-1

BERGEN-PATERSON, ANCHOR/DARLING OR
FRONEK HYDRAULIC FLOW PATH



FLOW DURING EXTENSION

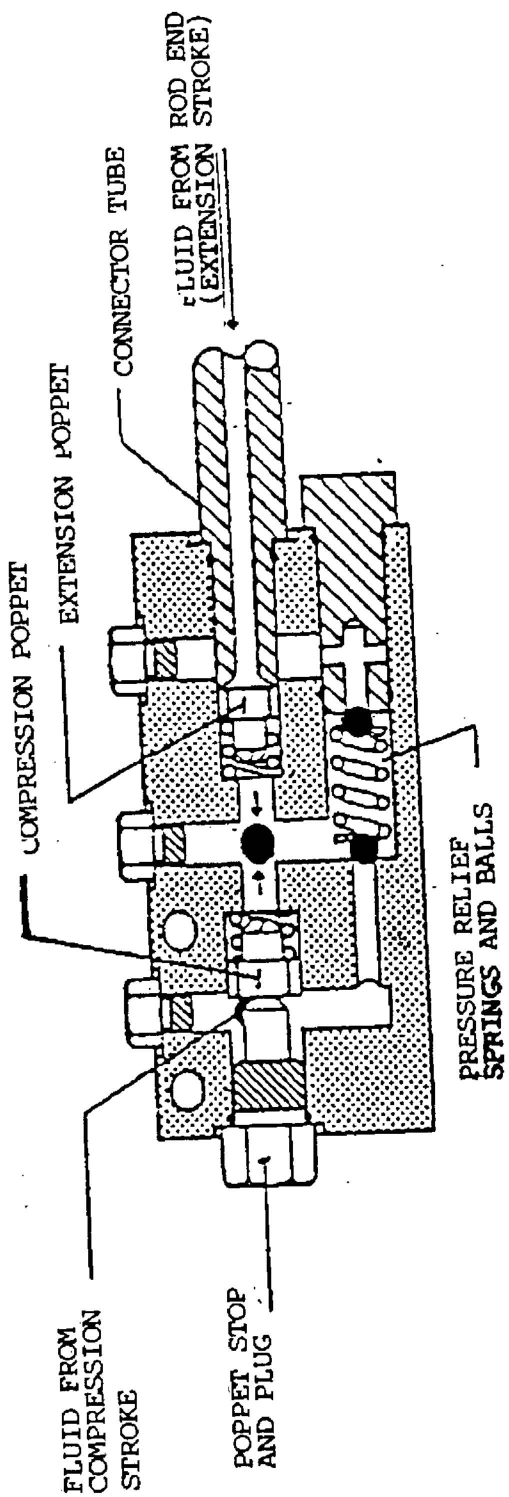


FLOW DURING RETRACTION

APPENDIX A
(Page 2 of 3)

ILLUSTRATION A-2

CONTROL VALVE ASSEMBLY FOR MANIFOLD DESIGN



APPENDIX A
(Page 3 of 3)

TABLE A-1

STANDARD BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK POPPETS

CYLINDER BORE	MODEL NUMBER	DIRECTION	BETWEEN FLATS *	NO. OF FLATS	PART NUMBER
1.5	HSSA-3	COMPRESSION	0.457"	2	202-1061-001
		EXTENSION	0.470"	2	202-1061-002
2.5	HSSA-10	COMPRESSION	0.415"	2	202-1061-003
		EXTENSION	0.435"	2	202-1061-004
3.25	HSSA-20	COMPRESSION	0.389"	2	202-1061-005
		EXTENSION	0.400"	2	202-1061-006
4.00	HSSA-30	COMPRESSION	0.389"	4	202-1061-007
		EXTENSION	0.410"	4	202-1061-008
5.00	HSSA-50	COMPRESSION	0.420″	4	202-1061-009
		EXTENSION	0.430″	4	202-1061-010
6.00	HSSA-70	COMPRESSION	0.375″	4	202-1061-011
		EXTENSION	0.410″	4	202-1061-012
8.00	HSSA-130	COMPRESSION	0.875″	4	202-1061-013
		EXTENSION	0.875″	4	202-1061-014

* Factory tolerance ± 0.0005"

APPENDIX B
(Page 1 of 2)

SUBGROUPING AND SERVICE LIFE MONITORING OF SNUBBERS

1.0 Subgrouping:

1.1 For functional testing, Subgroup 1 includes all sizes of Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers, except 12 inch bore Torus dynamic restraints.

1.2 When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do not fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required. Table B-1 of this SI must be revised when the subgroups change.

1.3 Snubbers tested from severe service areas will remain a part of their respective subgroup, unless a failure analysis is performed and a separate subgroup is justified and incorporated into this SI.

1.4 Severe service areas include inside the drywell and in the main steam valve vault room. There have been minimal failures of snubbers in these locations, therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

APPENDIX B
(Page 2 of 2)

TABLE B-1

SUBGROUPING AND SERVICE LIFE MONITORING OF SNUBBERS

Category Number	Subcategory Number (1)	Description	Quantity Unit 1	Unit 2	Unit 3
3*	1	Hydraulic Bergen-Paterson, Anchor/Darling, Fronek (HSSA-3-10-20 and-30) and (ADH-20-30-50-70 and-130)	22	24	11
12**	1	Hydraulic Bergen-Paterson, Anchor/Darling, Fronek (HSSA-3-10-20 and-30) and (ADH-20-30-50-70 and-130)	46	57	36

* These categories are accessible at any time during power operation for the purpose of functional testing.

** These categories are only accessible during an outage, when the reactor is in the cold shutdown mode or in the hot shutdown mode with special provisions from operations and Industrial Safety.

1. The subcategories are listed based on the design features and according to the manufacturer.

Total Bergen-Paterson, Anchor/Darling, and Fronek Hydraulic Snubbers in:

a) Unit 1 68
b) Unit 2 81
c) Unit 3 47

APPENDIX C
(Page 1 of 3)

BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK
HYDRAULIC SNUBBER ACCEPTANCE CRITERIA

AS-FOUND	
SIZE	LOCKUP IN/MIN
HSSA-3	1-30
HSSA-10	1-30
HSSA-20	1-30
HSSA-30	1-30
ADH-20	1-30
ADH-30	1-30
ADH-50	1-30
ADH-70	1-30
ADH-130	1-30

AS-LEFT	
SIZE	LOCKUP IN/MIN
HSSA-3	5-20
HSSA-10	5-20
HSSA-20	5-20
HSSA-30	5-20
ADH-20	5-20
ADH-30	5-20
ADH-50	5-20
ADH-70	5-20
ADH-130	5-20

APPENDIX C
(Page 2 of 3)

BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK
HYDRAULIC SNUBBER ACCEPTANCE CRITERIA

LOAD AND BLEED TABLE				
BERGEN-PATERSON 3				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
1000		0.6	4.95	33%
1500		1	7.5	50%
1800		1.2	9	60%
2000		1.34	10.05	67%
2400		1.6	12	80%
2500		1.66	12.45	83%
3000		2.0	15.0	100%
BERGEN-PATERSON 10				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
1000		0.2	1.5	10%
2000		0.4	3	20%
3000		0.6	4.5	30%
4000		0.8	6	40%
5000		1	7.5	50%
6000		1.2	9	60%
7000		1.4	10.5	70%
8000		1.6	12	80%
9000		1.8	13.5	90%
10000		2.0	15.0	100%
BERGEN-PATERSON, ANCHOR/DARLING (ADH), Fronek 20				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		0.5	2.5	25%
10000		1	5	50%
12000		1.2	6	60%
15000		1.5	7.5	75%
16000		1.6	8	80%
20000		2.0	10.0	100%
BERGEN-PATERSON, ANCHOR/DARLING (ADH), Fronek 30				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		0.33	1.67	17%
10000		0.66	3.34	33%
15000		1	5.01	50%
18000		1.2	6.01	60%
20000		1.33	6.68	67%
24000		1.59	8.02	80%
25000		1.66	8.35	83%
30000		2.0	10.0	100%

APPENDIX C
(Page 3 of 3)

BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK
HYDRAULIC SNUBBER ACCEPTANCE CRITERIA

LOAD AND BLEED TABLE				
ANCHOR/DARLING (ADH), Fronek 50				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
5000		.2	.8	10%
10000		.4	1.6	20%
15000		.6	2.4	30%
20000		.8	3.2	40%
25000		1.0	4.0	50%
30000		1.2	4.8	60%
35000		1.4	5.6	70%
40000		1.6	6.4	80%
45000		1.8	7.2	90%
50000		2.0	8.0	100%
ANCHOR/DARLING (ADH), Fronek 70				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
7000		.2	.8	10%
14000		.4	1.6	20%
21000		.6	2.4	30%
28000		.8	3.2	40%
35000		1.0	4.0	50%
42000		1.2	4.8	60%
49000		1.4	5.6	70%
56000		1.6	6.4	80%
63000		1.8	7.2	90%
70000		2.0	8.0	100%
ANCHOR/DARLING (ADH), Fronek 130				
		BLEED RATE		PERCENT
LOAD		MIN.	MAX.	LOAD
13000		.2	.8	10%
26000		.4	1.6	20%
39000		.6	2.4	30%
52000		.8	3.2	40%
65000		1.0	4.0	50%
78000		1.2	4.8	60%
91000		1.4	5.6	70%
104000		1.6	6.4	80%
117000		1.8	7.2	90%
130000		2.0	8.0	100%

APPENDIX D
(Page 1 of 1)

CORRECTION FOR TEMPERATURE

LOCKUP (ACTUATION)				BLEED (RELEASE)			
F	Correction	F	Correction	F	Correction	F	Correction
50	4	75	-1	50	1.00	75	-0.25
51	3.8	76	-1.2	51	0.95	76	-0.30
52	3.6	77	-1.4	52	0.90	77	-0.35
53	3.4	78	-1.6	53	0.85	78	-0.40
54	3.2	79	-1.8	54	0.80	79	-0.45
55	3	80	-2	55	0.75	80	-0.50
56	2.8	81	-2.2	56	0.70	81	-0.55
57	2.6	82	-2.4	57	0.65	82	-0.60
58	2.4	83	-2.6	58	0.60	83	-0.65
59	2.2	84	-2.8	59	0.55	84	-0.70
60	2	85	-3	60	0.50	85	-0.75
61	1.8	86	-3.2	61	0.45	86	-0.80
62	1.6	87	-3.4	62	0.40	87	-0.85
63	1.4	88	-3.6	63	0.35	88	-0.90
64	1.2	89	-3.8	64	0.30	89	-0.95
65	1	90	-4	65	0.25	90	-1.00
66	0.8	91	-4.2	66	0.20	91	-1.05
67	0.6	92	-4.4	67	0.15	92	-1.10
68	0.4	93	-4.6	68	0.10	93	-1.15
69	0.2	94	-4.8	69	0.05	94	-1.20
70	0	95	-5	70	0	95	-1.25
71	-0.2	96	-5.2	71	-0.05	96	-1.30
72	-0.4	97	-5.4	72	-0.10	97	-1.35
73	-0.6	98	-5.6	73	-0.15	98	-1.40
74	-0.8	99	-5.8	74	-0.20	99	-1.45
		100	-6			100	-1.50

NOTES:

1. Correction Factor is 0.2 in/min/°F for snubber lockup (actuation).
2. Correction Factor is 0.05 in/min/°F for snubber bleed (release).
3. These correction factors are for GE SF-1154 Silicone fluid.

APPENDIX E
(Page 1 of 2)

DAILY STARTUP PROCEDURE FOR THE STB-200 TEST BENCH

1. DAILY STARTUP PROCEDURE

1.1 WARM-UP

Exercise both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu.
Clicking on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, click on the bench label.

1.2 CHECK THE PRESSURE TRANSMITTER

NOTE: This instrument does not provide safety-related data. This check is optional.

In the Manual Control Panel mode, SELECT Manual in the Operating Mode block. Turn the "HP Pump" on, Then use the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi. Check the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

1.3 PARK THE RAM

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

1.4 SHUT DOWN THE MANUAL CONTROL PANEL

Click on "Shut Down" to exit the Manual Control Panel.

2. Status Check

2.1 During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and or the jog/drag valve.

2.2 The system should be checked for loose fittings, bolts, etc.

2.3 The filter indicators should be watched during cylinder stroking to insure that they are not illuminating.

2.4 If the indicators are illuminating, the filters should be changed before continuing with operation of the machine or any testing.

APPENDIX E
(Page 2 of 2)

DAILY STARTUP PROCEDURE FOR THE STB-200 TEST BENCH

3. Daily Calibration Checks

The following calibration checks assure the functionality of the instrument and Data Acquisition and control System (DAS) for testing. They do not take the place of full system calibrations which must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up to 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

3.1 SELECT THE DAILY CALIBRATION FUNCTION

SELECT the Daily Calibration Check function from the "Tools" menu.

3.2 CONNECT THE LOW RANGE LOAD CELL AS DIRECTED

If directed to by the software, electrically connect the Low Range Load Cell as instructed. The load cell does not need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

3.3 STORE THE "ZERO" CALIBRATION READINGS

For each instrument click the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.4 STORE THE "SPAN" CALIBRATION READINGS

For each instrument, press in the "CAL" button on the front of the instrument, then click the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.5 PRINT THE REPORT

When all readings for both benches have been stored, click on the "PRINT" button to print the Daily Calibration Report. If the report is "SATISFACTORY", continue the testing. If the report is "UNSATISFACTORY", halt and correct the problem before continuing.

APPENDIX F
(Page 1 of 1)

COMMON MODES OF SNUBBER FAILURE
AND POSSIBLE CAUSES

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong Size Poppet Wrong Size Poppet Spring Poppet Frozen or Blocked Open Excessively low or No Fluid Lockup Adjustment Set Improperly Damaged Piston Rod Seal Damaged "O" Ring
	High Lockup	Wrong Size Poppet Wrong Size Poppet Spring Lockup Velocity Adjustment Set Improperly Damaged "O" Ring
	Low Lockup	Broken Poppet Spring Poppet Frozen or Blocked Closed Lockup velocity Adjustment Set Improperly Foreign Objects in Fluid
	High Bleed	Defective or Damaged Poppet Defective or Damaged Poppet Seat Wrong Size Poppet Bleed Adjustment Set Improperly Damaged "O" Ring
	No Bleed	Foreign Objects in Fluid Bleed Adjustment Set Improperly
	Miscellaneous	Hardware Improper Installation Improper Handling or Abuse Misapplication Overload Vibration or Wear

APPENDIX G
(Page 1 of 6)

Service Life Monitoring for Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Snubbers

The service life of snubbers may be extended based on an evaluation of the records of functional tests, maintenance history, and environment conditions to which the snubbers have been exposed.

Seal service life of hydraulic snubbers shall be monitored to ensure that the service life of the seals is not exceeded. The maximum expected service life for various seals, seal materials and applications shall be estimated, based on engineering information and seals shall be replaced so that the maximum expected seal service life does not expire during a period when the snubber(s) are required to be operable. Based on current seal manufacturer's data and operating experience, ethylene propylene seals are expected to have a maximum service life of approximately 10 years for the Bergen-Paterson, Anchor/Darling, or Fronek hydraulic snubbers. This maximum seal service life may be extended to 17.3 years based on the evaluation results documented in Ref. 2.11.

The piston, piston rod, cylinder and glands are also subject to wear, especially in high vibration installations. Those, and other moving parts of the snubber, should be examined carefully each time the seals are replaced, and replacements made to prevent leakage or other conditions of inoperability before the next time the snubber is to be rebuilt.

To ensure that the seal service life does not expire and to distribute the work load between the refueling outages, replace the seals in approximately 10 percent of the Bergen-Paterson hydraulic snubbers each refueling outage. However, review the required seal service date shown on Appendix G and replace the seals whose required seal service date will occur before the next scheduled refueling outage, unless justification is provided for extending the service life of those seals. Seals replacement work shall be performed and documented in accordance with MPI-0-000-SNB002. Seal service life monitoring data shall be recorded on Appendix G.

Each time that the seal service life start and expiration dates change as a result of seals replacement, Appendix G, should be revised to incorporate current status of the seal service life.

APPENDIX G
(Page 2 of 6)
BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK SEAL SERVICE LIFE TABLE

UNIT 2		SEAL SERVICE LIFE			UNIT 2		SEAL SERVICE LIFE		
SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE	SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE
2-47B451R0033	HSSA-3	M0999	05-04-1999	05/04/2016	2-47B452S0157	HSSA-30	ADH-3000-780	04/09/1999	04/09/2016
RHR R-61L	ADH-3	ADH-2500-3-1086	11/16/2004	11/16/2021	2-47B452R0020 U	HSSA-20	M0167	10/06/1997	10/06/2014
RHR R-61 U	HSSA-3	M0183	05/05/1999	05/05/2016	RHR R-41 E	HSSA-3	M0467	05/04/1999	05/04/2016
RHR H-62	HSSA-10	M0479	10/22/2004	10/22/2021	RHR R-41 W	HSSA-3	ADH-300-2049	03/24/2001	03/24/2018
RHR R-158 N	HSSA-3	M0212	05/05/1999	05/05/2016	RHR R-19	HSSA-10	M0184	01/16/1996	01/16/2013
RHR R-158 S	ADH-3	ADH-300-2047	05/07/1999	05/07/2016	2-47B553S0009 E	HSSA-10	M0447	11/13/1998	11/13/2015
RCIC R-4 N	HSSA-3	M0090	01/03/2005	01/03/2022	2-47B456R0007L	HSSA-3	M0280	05/05/1999	05/05/2016
RCIC R-4 S	HSSA-3	M0070	05/03/1999	05/03/2016	2-47B456R0007U	HSSA-3	M0401	05/12/1999	05/12/2016
2-47B456R0005 E	HSSA-3	M0482	05/04/1999	05/04/2016	2-47B553R0003	HSSA-10	M0472	10/18/1994	10/18/2011
2-47B456R0005 S	HSSA-3	M0024	05/05/1999	05/05/2016	2-47B553R0010	HSSA-10	M0350	01/09/1996	01/09/2013
2-47B462S0025	HSSA-3	M0354	05/05/1999	05/05/2016	2-47B553R0004	HSSA-10	M0249	01/26/2001	01/26/2018
RHR R-10	HSSA-20	M0506	01/25/2001	01/25/2018	2-47B553S0011	HSSA-10	M0238	01/17/2001	01/17/2018
2-47B452R0054	HSSA-10	M0117	01/24/2001	01/25/2018	2-47B452S0250	HSSA-20	M0451	10/21/2004	10/21/2021
2-47B452S0245	HSSA-10	M0109	10/06/1994	10/06/2011	2-47B452S0251	HSSA-20	ADH-2003-795	05/08/1999	05/08/2016
RHR R-58	HSSA-10	M0140	02/08/2001	02/08/2018	2-47B452R0077	HSSA-3	M0204	05/04/1999	05/04/2016
2-47B56R0009N	HSSA-3	M0346	05/04/1999	05/04/2016	2-47B408S0061	ADH-70	ADH-7000-160	04/22/1999	04/22/2016
2-47B56R0009S	HSSA-3	M0421	05/04/1999	05/04/2016	2-47B408S0046	ADH-50	ADH-5003-278	03/16/2005	03/16/2022
2-47B452R0051N	HSSA-3	M0052	05/04/1999	05/04/2016	2-47B408S0063	ADH-70	ADH-7000-159	04/29/1999	04/29/2016
2-47B452R0051 S	HSSA-3	M0465	05/05/1999	05/05/2016	2-47B408S0047	ADH-50	ADH-5000-417	04/30/1999	04/30/2016
2-47B452R0052 W	HSSA-10	M0150	02/26/2001	02/26/2018	2-47B408S0062	ADH-50	ADH-5000-418	04/29/1999	04/29/2016
2-47B452R0053 E	HSSA-10	M0460	02/02/2001	02/02/2018	2-47B408S0042	HSSA-20	M0505	09/25/1997	09/25/2014
2-47B452R0053 N	HSSA-10	M0124	02/15/2001	02/15/2018	2-47B458S0004	HSSA-10	M0448	04/13/1999	04/13/2016
2-47B455R0019	HSSA-3	M0244	05/05/1999	05/05/2016	2-47B458S0005	HSSA-10	M0148	10/21/1994	10/21/2011
2-47B455R0020	HSSA-10	M0430	03/02/2001	03/02/2018	2-47B458S0006	HSSA-10	M0123	09/24/1997	09/24/2014

APPENDIX G
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BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK SEAL SERVICE LIFE TABLE

UNIT 2		SEAL SERVICE LIFE			UNIT 2		SEAL SERVICE LIFE		
SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE	SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE
2-47B458S0007	HSSA-10	M0442	02/28/2005	02/28/2022	2-47B400S0107	HSSA-10	M0290	04/25/1999	04/25/2016
2-47B408S0071	ADH-70	ADH-7000-158	04/24/1999	04/24/2016	2-47B400S0108	HSSA-20	M0329	04/16/1999	04/16/2016
2-47B408S0073	ADH-70	ADH-7000-161	04/20/1999	04/20/2016	2-47B400S0109	HSSA-20	M0154	01/07/1999	01/07/2016
2-47B408S0076	ADH-130	ADH-13000-28	04/24/1999	04/24/2016	2-47B400S0110	HSSA-20	M0272	12/07/1998	12/07/2015
2-47B408S0078	ADH-50	ADH-5000-415	04/29/1999	04/29/2016	2-47B452S0237	ADH-20	M0221	11/17/1998	11/17/2015
2-47B452S0235	HSSA-20	M0503	12/01/1998	12/01/2015	2-47B408S0082 S	ADH-30	ADH-3002-785	04/17/1999	04/17/2016
2-47B452R0240	ADH-30	ADH-3002-784	04/23/1999	04/23/2016	2-47B408S0082 N	ADH-30	ADH-3002-787	04/17/1999	04/17/2016
2-47B452S0227	ADH-30	ADH-3002-786	04/22/1999	04/22/2016	2-47B408S0081	ADH-30	ADH-3002-783	04/28/1999	04/28/2016
2-47B415S0001	HSSA-10	M0440	03/20/1993	03/20/2010					
2-47B415S0002	HSSA-10	M0406	04/14/1993	03/14/2010					
2-47B415S0003	HSSA-10	M0998	02/14/2001	02/14/2018					
2-47B415S0004	HSSA-10	M0420	01/20/2005	01/20/2022					
2-47B415S0005	HSSA-10	M0303	10/11/1994	10/11/2011					
2-47B415S0021	HSSA-10	M0479	10/12/1994	10/12/2011					
2-47B415S0010	HSSA-10	M0420	10/12/1994	10/12/2011					
2-47B415S0011	HSSA-10	M0431	10/14/1994	10/14/2011					
2-47B415S0012	HSSA-10	M0361	11/30/1999	11/30/2016					
2-47B415S0013	HSSA-10	M0112	10/16/1994	10/16/2011					
2-47B415S0014	HSSA-10	M0442	03/21/1993	03/21/2010					
2-47B400S0096	HSSA-20	M0458	02/15/2001	02/15/2018					
2-47B400S0097	HSSA-20	M01000	04/25/1999	04/25/2016					
2-47B400S0099	HSSA-30	M0168	03/24/2001	03/24/2018					
2-47B400S0103	HSSA-20	M0145	04/17/1999	04/17/2016					
2-47B400S0104	HSSA-30	M0038	03/03/2005	03/03/2022					
2-47B400S0105	HSSA-30	ADH-3000-781	04/21/1999	04/21/2016					

APPENDIX G
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BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK SEAL SERVICE LIFE TABLE

Unit 3		**SEAL SERVICE LIFE**			**Unit 3**		**SEAL SERVICE LIFE**		
SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE	SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE
RCIC R4 N	HSSA-3	ADH-300-2042	05/06/1999	05/06/2016	3-47B415-22	HSSA-10	M0186	01/25/2002	01/25/2019
RCIC R4 S	HSSA-3	M0004	05/06/1999	05/06/2016	3-47B400-115	HSSA-30	M0295	03/12/2004	03/12/2021
RCIC R5 E	HSSA-3	ADH-300-2043	05/07/1999	05/07/2016	3-47B400-89	HSSA-20	M0065	04/26/2000	04/26/2017
RCIC R5 S	HSSA-3	MO235	05/06/1999	05/06/2016	3-47B400-88	HSSA-20	M0167	11/03/2003	11/03/2020
CS R6 N	HSSA-10	MO201	03/07/2000	03/07/2017	3-47B400-101	HSSA-30	M0152	10/12/1995	10/12/2012
CS R6 S	HSSA-10	MO453	03/03/2000	03/03/2017	3-47B415-55	HSSA-10	M0406	11/07/2003	11/07/2020
3-47B458-96 N	HSSA-10	M0469	01/08/2002	01/08/2019	3-47B400-102	HSSA-30	ADH-3003-420	04/24/2000	04/24/2017
3-47B458-96 S	HSSA-10	M0382	02/13/2002	02/13/2019	3-47B415-53	HSSA-10	M0126	10/30/2003	10/30/2020
3-47B452-1544	HSSA-20	M0164	12/12/2003	12/12/2020	3-47B415-54	HSSA-10	M0229	03/24/2004	03/24/2021
3-47B452-1557	HSSA-30	MO868	03/12/2002	03/12/2019	3-47B415-52	HSSA-10	M0137	04/23/2000	04/23/2017
RHR R-41 IN	HSSA-3	M0033	02/15/2002	02/15/2019	3-47B400-104	HSSA-10	M0123	11/04/2003	11/04/2020
RHR R-41 OUT	HSSA-3	M0393	01/22/2002	01/22/2019	3-47B400-105	HSSA-20	M0505	01/04/2004	01/04/2021
RHR R-19	HSSA-10	M0109	12/10/2003	12/10/2020	3-47B415-59	HSSA-10	M0439	01/22/2002	01/22/2019
RCIC R7U	HSSA-3	M0209	05/07/1999	05/07/2016	3-47B415-20	HSSA-10	M0278	04/21/2000	04/21/2017
RCIC R7L	HSSA-3	M0070	11/06/2003	11/06/2020	3-47B415-19	HSSA-10	M0475	04/22/2000	04/22/2017
3-47B452-1494	HSSA-30	M0287	12/02/2003	12/02/2020	3-47B415-24	HSSA-10	M0289	01/22/2002	01/22/2019
3-47B452-1491	HSSA-30	M0039	03/14/2002	03/14/2019	3-47B415-23	HSSA-10	M0478	01/25/2002	01/25/2019
RCIC R9S	HSSA-3	ADH-300-2044	04/17/2000	04/17/2017	3-47B458-558	HSSA-10	M0322	01/28/2002	01/28/2019
RCIC R9N	HSSA-3	ADH-300-2045	04/17/2000	04/17/2017	3-47B458-559	HSSA-10	M0112	11/04/2003	11/04/2020
RHR R-158 N	HSSA-3	M0999	10/30/2003	10/30/2020	3-47B415-64	HSSA-10	M0148	10/30/2003	10/30/2020
RHR R-158 S	HSSA-3	M0286	05/07/1999	05/07/2016	3-47B458-566	HSSA-10	M0184	11/08/2003	11/08/2020
3-47B462-27	HSSA-3	M0078	02/20/2002	02/20/2019	3-47B458-567	HSSA-10	M0339	01/28/2002	01/28/2019
3-47B400-121	HSSA-20	M0166	09/01/1995	09/01/2012	RHR R-10	HSSA-20	M0327	03/21/2002	03/21/2019
3-47B415-21	HSSA-10	M0468	01/16/2002	01/16/2019					

APPENDIX G
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BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK SEAL SERVICE LIFE TABLE

Unit 1		**SEAL SERVICE LIFE**			**Unit 1**		**SEAL SERVICE LIFE**		
SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE	SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE
HPCI R47 U	HSSA-3	M0282			CONDSS&S R4N	HSSA-10	M0158		
HPCI R47 L	HSSA-3	M0337	11/03/1982	-See Book #7	CONDSS&S R4E	HSSA-10	M0153		
RCIC R4 N	HSSA-3	M0315	11/07/1982	-See Book #7	CONDSS&S R5U	HSSA-10	M0365		
RCIC R4 S	HSSA-3	M0348	11/03/1982	-See Book #7	CONDSS&S R5L	HSSA-10	M0114	06/27/1989	-See Book #6
RCIC R5 E	HSSA-3	M0313	11/07/1982	-See Book #7	RHR R20 U	HSSA-30	M0379	11/29/1982	-See Book #7
RCIC R5 S	HSSA-3	M0345	11/18/1982	-See Book #7	RHR R20 L	HSSA-30	M0036		
RHR R0007	HSSA-10	M0133			RHR S0175	HSSA-20	M0061		
RHR S0204	HSSA-10	M0060			RHR R0012	HSSA-20	M0330	01/10/1983	-See Book #7
RHR R0006	HSSA-10	M0347	10/26/1982	-See Book #7	RCIC R9 N	HSSA-3	M0316	11/07/1982	-See Book #7
RHR R1 N	HSSA-3	M0045			RCIC RH S	HSSA-3	M0314	11/06/1982	-See Book #7
RHR R1 S	HSSA-10	E0105			RHR R9 N	HSSA-20	M0331	11/22/1982	-See Book #7
RHR R3	HSSA-10	M0311	09/02/1982	-See Book #7	RHR R9 S	HSSA-20	M0369	01/10/1983	-See Book #7
RHR R4 E	HSSA-10	M0301	08/25/1982	-See Book #7	RHR R21 E	HSSA-3	M0349	11/06/1982	-See Book #7
RHR R4 W	HSSA-10	M0318	12/14/1982	-See Book #7	RHR R21 W	HSSA-3	M0371	11/16/1982	-See Book #7
HPCI R90	HSSA-20	M0135			RHR R22	HSSA-10	M0312	12/06/1982	-See Book #7
RHR R2	HSSA-10	M0342	10/27/1982	-See Book #7	SLC R21	HSSA-3	M0372	11/21/1982	-See Book #7
HPCI R3 N	HSSA-3	M0068			FP S0195	HSSA-3	E0268		
HPCI R3 S	HSSA-3	M0050			FP S0205	HSSA-3	M0054		
CONDSS&S R1U	HSSA-10	M0099	11/19/1982	-See Book #7	FP R4	HSSA-3	M0356	11/09/1982	-See Book #7
CONDSS&S R1L	HSSA-10	M0352	11/17/1982	-See Book #7	RHR R25	HSSA-10	M0125		
CONDSS&S R2S	HSSA-10	M0344	12/09/1982	-See Book #7	HPCI R6	HSSA-3	M0072		
CONDSS&S R2N	HSSA-10	M0305			RHR R24	HSSA-10	M0518		
RCIC R7 L	HSSA-3	151981B			FW SSA2	HSSA-10	M0178		
RCIC R7 U	HSSA-3	M0049			FW SSA1	HSSA-10	M0202		
CONDSS&S R3E	HSSA-10	M0332	12/07/1982	-See Book #7	FW SSA3	HSSA-10	M0013		

APPENDIX G
(Page 6 of 6)

BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK SEAL SERVICE LIFE TABLE

Unit 1		SEAL SERVICE LIFE			Unit 1		SEAL SERVICE LIFE		
SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE	SUPPORT #	TYPE/ SIZE	SERIAL #	LAST SEAL SERVICE DATE	REQUIRED SEAL SERVICE DATE
CONDS S&S R3W	HSSA-10	M0368	12/23/1983	-See Book #7	FW SSB4	HSSA-10	M0113		
FW SSA4	HSSA-10	M0142			MS SSC4	HSSA-10	M0265	06/17/1981	-See Book #7
RHR R26	HSSA-10	M0136			MS SSC5	HSSA-10	M0317	12/27/1982	-See Book #7
MS SSB4	HSSA-10				MS SSC6	HSSA-20	M0385	06/03/1983	-See Book #7
MS SSB6	HSSA-20	M0403	08/12/1983	-See Book #7	FW SSB1	HSSA-10	M0144		
MS SSB5	HSSA-10	M0048			FW SSB2	HSSA-10	M0360	10/26/1982-	See Book # 7
FW SSA6	HSSA-10	M0215			CS R8	HSSA-10	M0307	10/20/1982-	See Book # 7
FW SSA7	HSSA-10	M0127	10/19/1982	-See Book #7	CS R9	HSSA-10	M0103		
MS SSB2	HSSA-30	M0169			CS R2	HSSA-10	M0042	09/03/1986	-See Book #7
MS SSA2	HSSA-20	M0216			CS R1	HSSA-10	M0158		
FW SSA5	HSSA-10	M0234			SLC R19	HSSA-3	M0240	04/07/1982	-See Book #7
MS SSA1	HSSA-20	M0065			RHR R29W	HSSA-3	E0082		
MS SSB1	HSSA-20	M0386			RHR R29E	HSSA-3	M0375	11/20/1982	-See Book #7
FW SSA8	HSSA-10	M0147							
FW SSA9	HSSA-10	M0338	10/26/1982	-See Book #7					
FW SSB8	HSSA-10	M0043							
FW SSB9	HSSA-10	M0304	11/02/1982	-See Book #7					
MS SSC1	HSSA-30	M0170							
MS SSD1	HSSA-20	M0182							
FW SSB5	HSSA-10	M0321							
MS SSC2	HSSA-30	M0295	06/29/1982	-See Book #7					
FW SSB7	HSSA-10	M0300	10/28/1982	-See Book #7					
MS SSD2	HSSA-20	M0378	11/29/1982	-See Book #7					
FW SSB6	HSSA-10	M0203							
FW SSB3	HSSA-10	M0367	11/02/1982	-See Book #7					

ATTACHMENT 1
(Page 1 of 1)

SURVEILLANCE INSTRUCTION REVIEW FORM

DATE/TIME STARTED ____________ DATE/TIME COMPLETED __________

REASON FOR TEST: PLANT MODE 1 2 3 4 5 (Circle Appropriate Mode)

_____ Scheduled Surveillance
_____ System Inoperable (Explain in Remarks)
_____ Maintenance (WO# ______________)
_____ Other (Explain in Remarks)

MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING

FLUID TYPE________________ TIIC/STOCK NO.__________________ 575N/SIR______________

PRE-TEST REMARKS: ____
____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)

NOTE:
The following entries for contacting Shift Manager/Unit Supervisor shall mark N/A if the snubber is not Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted _____________ Date _____ Time _____

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted _____________ Date _____ Time _____

==

SECTION REVIEWER (MM) -_________________________________ Date _____________

==

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was fully complete except as noted in Post-Test Remarks.

SNUBBER ENGINEER/
SITE CIVIL ENGINEERING REVIEWER - ________________________ Date _________

==

SCHEDULING COORDINATOR - _________________________________ Date _________

==

POST-TEST REMARKS: ____ FREQ -
____ FREQ IN RO -
____ KEY - 2395B

ATTACHMENT 2
(Page 1 of 4)
AS FOUND SNUBBER TEST DATA

Date: ________________
System Number: _______
Snubber UNID Number: _______________
Serial Number: __________
Exam Number: ____________
Snubber Rated Load: ________________
Temperature Correction: _____________

Thermometer Number: ____________
Calibration Due Date: __________
Load Cell Number: ______________
Calibration Due Date: __________
Work Order Number: _____________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Acceptance Criteria*	
Tension	________	________	________	1 in/min ≤ Corrected Activation ≤ 30 in/min	____________ Performer Signature
Compression	________	________	________		________ Date
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension	________	________	________	Bleed takes place after snubber activation	____________ Performer Signature
Compression	________	________	________		________ Date
	Load(lbs)				
Tension		N/A	N/A	None	____________ Performer Signature
Compression		N/A	N/A		________ Date
	Drag (lbs)			2% of snubber rated load	
Tension Max:	________	N/A	N/A	Rated Load X 0.02 = ________	____________ Performer Signature
Tension Avg:	________				
Compression Max:	________				
Compression Avg:	________	N/A	N/A		________ Date

Copy of the plotted as-found test results is attached to this data sheet. __________/________ Initials / Date

* Case Specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Found Acceptance Criteria ___ Yes ___ No

If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

______________________________/________
Snubber Engineer/SE-Designee Date

ATTACHMENT 2
(Page 2 of 4)
AS LEFT SNUBBER TEST DATA

Date: ______________
System Number: ____________ Thermometer Number: ____________
Snubber UNID Number: ______________ Calibration Due Date: __________
Serial Number: ____________
Exam Number: ______________ Load Cell Number: ______________
Snubber Rated Load: ______________ Calibration Due Date: __________
Temperature Correction: ____________ Work Order Number: ______________

	Activation (in/min)	Temp Correction (in/min)	Corrected Activation (in/min)	Acceptance Criteria	
Tension Compression	_______ _______	_______ _______	_______ _______	5 in/min ≤ Corrected Activation ≤ 20 in/min	________________ Performer Signature _________ Date
	Bleed (in/min)	Temp Correction (in/min)	Corrected Bleed (in/min)		
Tension Compression	_______ _______	_______ _______	_______ _______	Corrected bleed takes place after snubber activation and shall be within the range shown in App. C for the size snubber	________________ Performer Signature _________ Date
	Load lbs)				
Tension Compression		N/A N/A	N/A N/A	None	________________ Performer Signature _________ Date
	Drag lbs)				
Tension Max: Avg: Compression Max: Avg:	 _______ _______ _______ _______	N/A N/A	N/A N/A	Less than 2% of snubber rated load Rated Load X 0.02 = ___	________________ Performer Signature _________ Date

Copy of the plotted As-Left test results is attached to this data sheet. __________/______
Initials Date

Snubber meets As-Left Acceptance Criteria ___ Yes ___ No

Review test data for acceptability. If the test results are unacceptable, DO NOT install snubber in any piping system, component, or feature in the plant.

______________________________/_______
Snubber Engineer/SE-Designee Date

ATTACHMENT 2
(Page 3 of 4)

REMOVAL AND REINSTALLATION OF BERGEN PATERSON HYDRAULIC SNUBBERS

WO No. _____________ Unit _ Snubber UNID No. ________________

Serial No. _____ Subgroup _________ Test Lot: Initial _____ Subsequent _____

Exam No. ________ Size ______ Rated Load __________ Lbs. Pipe Size _____

Design drawing number _______________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of snubber for functional testing.

____________________________ ___________ _________
Foreman/Designee Date Time

As-Found Stroke Setting __________

Required Stroke Setting __________
(from Design drawing)

Pipe Temp.:_____ ^{0}F, If other than ambient (per 0-47B435-5F, Note 24), notify Snubber Engineer/Site Engineering Civil.

Pryometer No.:___________ Calibration Due Date:___________

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

_____Yes _____No ___________________ /_______ (AC)
Performer Signature Date

All fasteners in the As-Found snubber(s) are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer is "No" complete Attachment 6.

_____Yes _____No ___________________ /_______ (AC)
Performer Signature Date

ATTACHMENT 2
(Page 4 of 4)

REMOVAL AND REINSTALLATION OF BERGEN PATERSON HYDRAULIC SNUBBERS

WO No. ______________ Unit _ Snubber UNID No. _________________

Snubber reinstallation:

Same snubber reinstalled	___Yes ___No
If No, enter serial number	Serial Number ________
Snubber is reinstalled in proper location	___Yes ___No
Snubber is reinstalled with base of housing up (for vertical snubbers)	___Yes ____No ___N/A
All locking devices are secured	___Yes ____No
cotter pins are spread	___Yes ____No ___N/A
Spherical bearing greased	___Yes ____No ___N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___Yes ____No
Snubber is tagged	___Yes ____No
Bolts and jam nuts torqued	___Yes ____No ___N/A
Anti-seize compound applied, as needed	___Yes ____No ___N/A

Torque Wrench No. ______________
Calibration Due Date __________
As-Left Stroke Setting ________

________________________/________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown on the design drawing.

______ Yes ______ No

________________________/________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

___________________/________
Foreman/Designee Date

Remarks:____

ATTACHMENT 3
(Page 1 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ PER No. _________________ Mfg./Size _______________

Serial No. ________ Rated Load ___________ Exam No. _____ Lot _____

1. Describe the mode of failure(s), as discussed on Appendix F.

☐ Locked up ☐ High Drag Force
☐ Snubber would not activate ☐ Damage to snubber hardware

Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix F for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release, or locked up, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No
If yes, contact the Maintenance Snubber Engineer/SE Designee for further actions to be taken. Explain Evaluation:

ATTACHMENT 3
(Page 2 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. ______ PER No. __________________ Mfg./Size ________________

Serial No. _________ Rated Load ___________ Exam No. ______ Lot ______

5. Snubber Failure is classified as: ☐ Isolated ☐ Location
☐ Manufacturing ☐ Design ☐ Unknown ☐ Other

Describe the basis for the classification

6. <u>For Subgrouping Purposes Only</u> - Evaluation of subgroup composition (new type snubber, changing subgroup of existing snubber, etc.)

7. Does the vendor need to be contacted? ☐ Yes ☐ No
Vendor Name:
Person contacted: Date:
Vendor's Comments:

8. What subsequent testing is required because of this failure?

Subsequent Lot No. No. of snubbers to be tested

9. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ________________________________/________
Snubber Engineer/SE-Designee Date

ATTACHMENT 4
(Page 1 of 1)

SUPPORTED SYSTEM/COMPONENT ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ PER No. _________________ Mfg./Size ____________

Serial No. ________ Rated Load __________ Exam No. _____

1. Describe the condition(s) (Whether the snubber would not activate, was the snubber locked up, or excessive drag force, etc.)

2. Attach the SE Evaluation of the attached component:

3. Based on the results of the Engineering Evaluation, has the snubber failure mode adversely affected the supported system or component.

_____ Yes _____ No

________________________________/______
Snubber Engineer/SE-Designee Date

ATTACHMENT 5
(Page 1 of 1)

CASE SPECIFIC ACCEPTANCE CRITERIA

WO No. _____________ Unit _ Snubber UNID No. ________________

Subgroup No. _____ PER No. ________________ Mfg./Size ___________

Serial No. ________ Rated Load __________ Exam No. _____

1. Describe the standard acceptance criteria:

☐ As-Found ☐ As-Left

2. Record the parameter(i.e., actuation, bleed, drag) and the test results that are outside the standard acceptance criteria:

☐ As-Found ☐ As-Left

3. Specify the Case Specific Acceptance Criteria and provide justification.

________________________/________

Site Engineering Civil Date

ATTCHMENT 6
(Page 1 OF 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners used for attachment of snubber(s) to component, and to anchorage, are discovered loose or missing prior to the As-Found functional testing.

WO No. ______________ Unit _ Date Discovered ____________

Snubber UNID No. _________________ Serial No. _____ Subgroup __________

Exam No. _________ Size ______ Rated Load ___________ Lbs. Pipe Size _____

1. Describe the discovered condition(s): ____
____
____

2. If possible, determine cause: ____
____
____
____
____

Evaluated by: _________________ / _________
Date

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.
____
____
____
____
____

Evaluated by: _________________ / _________
Date

4. Describe the corrective action(s) and provide the As-Found test result.
____
____
____
____
____

Evaluated by: _________________ / _________
Date

Attachment E

BFN SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2C,

Functional Testing of Bergen-Paterson Torus Dynamic Restraints

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2C

FUNCTIONAL TESTING OF BERGEN-PATERSON TORUS DYNAMIC RESTRAINTS

REVISION 3

PREPARED BY: JIMMY E. KIKER PHONE: 7341

RESPONSIBLE ORGANIZATION: SITE ENGINEERING-CIVIL DESIGN

APPROVED BY: ERIC J. FREVOLD DATE: 07/11/2006

EFFECTIVE DATE: 07/11/2006

LEVEL OF USE: CONTINUOUS USE

QUALITY-RELATED

REVISION LOG

Procedure Number: 0-SI-4.6.H-2C Revision Number: 3

Pages Affected: Cover Sheet, Revision Log, 2 thru 6,8,12,15,19,20,22 and 24 thru 28.

Description of Change: IC-04

This procedure is being revised to update total number of Bergen-Paterson Torus Dynamic Restraint in Table A-1 and remove all references to Unit 1 procedures to support the Restart of BFN Unit 1 and incorporate changes to clarify technical considerations of the Surveillance Instruction. This procedure represents the current system configuration and incorporates all associated DCNs.

This procedure is not being converted to the XP format at the request of the Unit 2/3 Lead Civil Engineer and Sponsor.

TABLE OF CONTENTS

1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for functional testing of Bergen-Paterson Torus Dynamic Restraints, as given in the Snubber Program Procedure (0-TI-398).

1.2 Scope

NOTES:

1. For the purposes of this instruction, the snubbers are categorized into two major groups, based on whether the snubbers are accessible or inaccessible during reactor operation. These major groups may further be divided into subgroups based on design of the snubbers or may be established by engineering analysis based on environment or other failures which may be expected to affect the operability of the snubbers within the group.

2. The terms group or category may be used interchangeably throughout this instruction.

3. Visual verification of snubbers is implemented by Surveillance Instructions 2-SI-4.6.H-1, and 3-SI-4.6.H-1.

4. This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Bergen-Paterson Torus Dynamic Restraints, Type/Size BP-12 as follows:

   - Removal and reinstallation of Bergen-Paterson Torus Dynamic Restraint snubbers to facilitate testing is accomplished in accordance with MPI-0-000-SNB004 and recorded in Attachment 2.

   - Provides the requirements for functional testing and service life monitoring of Bergen-Paterson Torus Dynamic Restraint snubbers. This instruction covers subgroup 5 only (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements (TR) functional testing requirements, Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2D, and 0-SI-4.6.H-2E must also be performed.

   - Provides guidance in the operation of the snubber test equipment.

   - Provides a means for the control and documentation of all snubber surveillance activities provided in this Surveillance Instruction.

   - This Surveillance Instruction shall be used to verify operability of the Torus Dynamic Restraint snubbers suspected inoperable during performance of the visual inspection SIs.

1.3 Frequency/Conditions

1.3.1 This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 2-SI-4.6.H-1, 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers.

1.3.2 All safety related snubbers shall be operable during all modes of operation as described in Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

1.3.3 Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

1.3.4 A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported component or system inoperable and follow the appropriate action statement for that system.

1.3.5 For inoperable snubber(s), within 72 hours, replace or restore inoperable snubbers to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does not meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM.
The engineering evaluation is to determine if component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting its design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

1.3.6 Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

1.3.7 For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found, or all snubbers in that subgroup have been tested, or all suspect snubbers identified by the failure analysis have been tested, as applicable. The failure analysis shall be used, as applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers that may also be subject to the same failure mode.

1.3 Frequency/Conditions (Continued)

1.3.8 New, replaced, or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

2.1 Technical Requirements Manual TR 3.7.4, Snubbers.

2.2 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.3 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.4 MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

2.5 BFN-VTM-B209-0160, Vendor Technical Manual for Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressors.

2.6 PE-8997-P1, Special 4 inch Tapered Pin Installation and Removal Procedure.

2.7 0-TI-398, Snubber Program Procedure

2.8 SPP-3.1, Corrective Action Program

2.9 SPP-6.4, Measuring and Test Equipment

2.10 SPP-8.1, Conduct of Testing

3.0 PRECAUTIONS AND LIMITATIONS

NONE

4.0 PREREQUISITES

The Technical Contract Manager (TCM) or Snubber Engineer shall ensure the following have been complied with, for contractor M&TE used on site, prior to the beginning of any work.

4.1 ENSURE SPP-6.4 has been referenced in the appropriate Work Order (WO) package(s), and necessary steps have been added to the functional testing contract to ensure all requirements of SPP-6.4 have been complied with.

4.2 INFORM all contractors or vendors, using M&TE onsite, of the requirements of SPP-6.4 before performance of M&TE related activities, particularly, concerning non-conforming M&TE.

4.0 PREREQUISITES (Continued)

4.3 The contractor or vendor personnel performing SR/QR activities shall provide documentation that the M&TE has a certified calibration from an Approved Suppliers List (ASL) listed calibration facility.

4.4 After use, documentation of post-use calibration is provided within 90 days of the departure of the M&TE from the site.

4.5 Six months prior to each refueling outage, ensure a minimum of two(2) of the new Lisega Torus Dynamic Restraint snubbers have been tested and are ready for installation, if required. No paperwork is required, since these snubbers are not under the Section XI Repair and Replacement Program.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

	DESCRIPTION	SIZE	QUANTITY
5.1	Rigging-Slings, Hoists, etc.	As required	As required
5.2	SF-1154 Silicone Fluid		As required
5.3	Porta-Power	Compact	1
5.4	Strap Wrench	As required	As required
5.5	Snubber Test Machine	As required	1
5.6	Positioning Fixture	(BP P/N 78044)	1
5.7	Hand Spanner Wrench	(BP P/N 78031)	1
5.8	Lifting Fixture	(BP P/N 78048)	1
5.9	Jam Nut Torquing Fixture	(BP P/N 78022)	1

6.0 ACCEPTANCE CRITERIA

6.1 Responses which fail to meet the As-Found Acceptance Criteria require immediate notification of the Snubber Engineer/SE designee at the time of failure.

6.2 "As-Found"

6.2.1 Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

NOTE:

For As-Found testing the only requirement for the bleed rate is that there is bleed after the snubber activates.

6.2.2 Bleed shall take place after activation of the snubber, in both tension and compression.

6.2.3 Drag forces shall be less than or equal to 15,000 pounds.

6.2.4 Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.3 "As-Left"

6.3.1 Activation shall occur in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

6.3.2 Bleed shall take place after activation of the snubber, in both tension and compression and be greater than or equal 1 inch/minute and less than or equal 10 inches/minute.

6.3.3 Drag force shall be less than or equal to 15,000 pounds.

6.3.4 Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.4 There shall be no loose or missing fasteners for attachment of the "As-Found" dynamic restraint(s) to the component or the anchorage. Otherwise, complete Attachment 6.

6.5 The stroke setting shall be within the limits shown on the design drawing.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

7.1.1 Thorough briefing should be conducted on SI performance prior to starting.

7.1.2 The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director and a Technical Contract Manager (TCM) since this work is performed by a contractor.

7.1.3 Appropriate General Employee Training (GET) should be received by contractor personnel prior to performing this SI.

7.1.4 Contractor must provide the TCM or Snubber Engineer a set of qualification certificates prior to beginning any work. The TCM shall place certifications in the Work Orders for the functional test being performed.

7.2 Preparation of Test Data Package

7.2.1 SELECT snubbers for retest which were placed in the same location as snubbers which failed during the previous outage, if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

7.2.2 DETERMINE the initial test lot (sample plan) as follows:

- SELECT 10 percent of the snubbers from subgroup 5 (see Appendix A).
- SELECT the snubbers with the most time from the previous test.
- SELECT snubber(s) that must be tested per an engineering evaluation, if applicable.
- SELECT snubbers that have experienced severe transients.
- SELECT snubbers that leak the most hydraulic fluid.
- FILL OUT the applicable section(s) of Attachment 2, as required.

7.2 Preparation of Test Data Package (Continued)

7.2.3 REVIEW the applicable support drawings to verify the location and any conditions that will require special preparation or equipment.

7.2.4 REQUEST scaffold or similar devices to be built or available, as necessary.

7.2.5 ENSURE Prerequisites concerning Contractor used M&TE have been complied with prior to any work being performed.

7.3 "As-Found" Functional Testing of Bergen-Paterson Torus Dynamic Restraints

NOTE:

1. When performing the "As-Found" functional test per this instruction, do not add fluid, bleed, stroke, or perform any adjustments or maintenance prior to testing. Insofar as possible, the test should be strictly "As-Found" and record the results on Attachment 2.

2. Ensure the test machine has been connected and perform test in accordance with Appendix C.

7.3.1 ENTER the required snubber information on Attachment 2.

7.3.2 The Bergen-Paterson Torus Dynamic Restraints may be tested by an in-place test machine, such as the Enertech TESTAN II, API/BARKER In-Place Snubber Test Machine or equal.

7.3.3 After the completion of the test, OBSERVE that the restraint's corrected lockup is between 6 and 25 inches per minute (inclusive) and bleeds after lockup for establishing operability of the snubber in the "As-Found" condition, as given in Section 6.2.

7.3.4 RECORD all necessary information on Attachment 2.

7.3.5 VERIFY that the drag force of the restraint is less than or equal to 15,000 pounds.

7.3.6 ENTER this information on Attachment 2.

7.3.7 DETERMINE if the "As-Found" test results meet the acceptance criteria in Section 6.2.

7.3.8 COMPARE the "As-Found" test results of the restraint with the "As-Left" range given in Section 6.3. If the test results are within the acceptable range for the "As-Left" criteria, PREPARE the restraint for reinstallation. If not, REPLACE the snubber with a Lisega large bore snubber.

7.3 "As-Found" Functional Testing of Bergen-Paterson Torus Dynamic Restraints (Continued)

7.3.9 If a snubber fails to meet the functional test acceptance criteria, PERFORM the following:

- NOTIFY the Snubber Engineer/SE Designee immediately for determination of further actions.
- REQUEST a Case Specific Acceptance Criteria evaluation using Attachment 5.
- REQUEST a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.

NOTE:

A subsequent test lot (sample plan) equal to 10 percent of the remaining restraints in the subgroup shall be functionally tested for each failed restraint. The subsequent test will include only restraints within the subgroup, unless the failure analysis indicates that the failure may be generic to snubbers in other subgroups.

7.3.10 DETERMINE the subsequent test lot (sample plan), as required.

7.3.11 Select 10% of the remaining snubbers from subgroup 5, based on selection Criteria from section 7.2.2.

7.3.12 ENSURE test data package is ready for Shift Manager/Unit Supervisor authorization.

7.3.13 PERFORM Sections 7.3 and 7.4 for subsequent test lot (sample plan).

7.4 "As-Left" Testing of Bergen-Paterson Torus Dynamic Restraints

NOTE:

1. The "As-Left" test must meet the acceptance criteria of Section 6.3.

2. If applicable ensure the test machine has been connected and perform test in accordance with Appendix C.

7.4.1 If the results of Step 7.3.8 fall within the acceptance criteria for activation velocity and bleed rate range, reinstall snubber per MPI-0-000-SNB004.

7.4.2 ENTER the snubber number, WO number, system number, serial number, and test equipment information on Attachment 2.

7.4 "As-Left" Testing of Bergen-Paterson Torus Dynamic Restraints (Continued)

7.4.3 Using the Enerpac cylinder or the in-place test machine, STROKE the snubber in both directions slowly and REPEAT stroking several times to refill the snubber and purge trapped air.

7.4.4 RECORD the "As-Left" test results on Attachment 2.

7.5 Results Evaluation

NOTE:

The following reviews are performed by the Snubber Engineer/SE Designee or a representative of Site Engineering (CIVIL).

7.5.1 COMPARE the As-Found or As-Left test results on Attachment 2 to the acceptance criteria given in Section 6.2 or 6.3. If the As-Found or As-Left test results exceed the allowable for activation, bleed, and drag force, perform a case specific evaluation on Attachment 5, as necessary.

7.5.2 REVIEW all of the test data on Attachment 2.

7.5.3 If any snubber is determined to not meet the As-Found acceptance criteria:

- NOTIFY the Shift Manager/Unit Supervisor of the inoperable snubber.
- INITIATE a PER in accordance with SPP-8.1 and SPP-3.1.
- INITIATE a WO to replace the snubber with a Lisega large bore snubber.
- Perform the supported system/component evaluation on Attachment 4.
- PERFORM a failure evaluation of any inoperable snubber and DOCUMENT on Attachment 3.
- SELECT the subsequent test lot (sample plan).

7.6 Data Sheet Review

7.6.1 VERIFY the WO to remove and reinstall the snubber has been initiated, as necessary and ENTER the WO number in the remarks section of Attachment 2.

7.6.2 VERIFY that all applicable Attachments are completed for the snubber(s) tested.

7.6 Data Sheet Review (Continued)

7.6.3 VERIFY the failure analysis of any failed snubber has been performed in accordance with Attachment 3 (disassembly may be necessary).

7.6.4 REVIEW the Site Engineering (Civil) evaluation of the supported component or system analysis Attachment 4, if applicable.

7.6.5 VERIFY the Case Specific Acceptance Criteria, Attachment 5, has been prepared, as applicable.

7.6.6 VERIFY the Snubber Engineer/SE Designee has reviewed all of the attachments and all acceptance criteria have been met.

7.6.7 VERIFY Contractor has provided the Snubber Engineer/SE Designee with appropriate documentation of all M&TE used on site.

7.6.8 REVIEW the completed SI package for final acceptance.

7.6.9 Prior to WO closure, VERIFY a copy of the pre-use and post-use calibration documentation are in the WO package.

NOTE:
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuild, etc., shall be submitted with the SI data package.

7.6.10 SUBMIT the completed package for closure.

8.0 APPENDIX/ATTACHMENTS

Appendix A - Subgrouping and Service Life Monitoring of Snubbers
Appendix B - Common Modes of Snubber Failure and Possible Causes
Appendix C - Wyle Laboratories procedure for In-Place Hydraulic Snubber Testing Using the API Test System

Attachment 1 - Surveillance Instruction Review Form
Attachment 2 - As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Bergen Torus Dynamic Restraints
Attachment 3 - Engineering Failure Analysis for Inoperable Snubbers
Attachment 4 - Supported System/Component Analysis for Inoperable Snubbers
Attachment 5 - Case Specific Acceptance Criteria
Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners

APPENDIX A
(Page 1 of 1)

SUBGROUPING AND SERVICE LIFE MONITORING OF SNUBBERS

1.0 SUBGROUPINGS

For functional testing, the snubbers are divided into one subgroup as described below:

1.1 Subgroup 5 Bergen-Paterson 12 inch bore and Lisega Torus dynamic restraint hydraulic snubbers. For functional testing of Lisega snubbers, see 0-SI-4.6.H-2E.

1.2 When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do not fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required. Table A-1 of this SI must be revised when the subgroups change.

1.3 There have been no failures of snubbers in these locations at this time; therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

TABLE A-1

SUBGROUPING OF SNUBBERS

Category Number	Subgroup Number (1)	Description	Quantity Unit 2	Quantity Unit 3
7*	5 (BP 12 only)	Hydraulic Bergen-Paterson (Torus, 12" bore)	9	12

* This category is accessible at any time during power operation for the purpose of functional testing.

1. The subgroup listed is based on the design features and according to the manufacturer.

Total Bergen-Paterson Torus Dynamic Restraints in Unit 2 and 3 = 21.

APPENDIX B
(Page 1 of 1)

COMMON MODES OF SNUBBER FAILURE AND POSSIBLE CAUSES

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong size poppet. Wrong size poppet spring. Poppet frozen or blocked open. Excessively low or no fluid. Lockup adjustment set improperly. Damaged piston rod seal. Damaged O-ring.
	High Lockup	Wrong size poppet. Wrong size poppet spring lockup velocity. Adjustment set improperly. Damaged O-ring.
	Low Lockup	Broken poppet spring. Poppet frozen or blocked closed. Lockup velocity. Adjustment set improperly. Foreign objects in fluid.
	High Bleed	Defective or damaged poppet. Defective or damage poppet seat. Wrong size poppet. Bleed adjustment set improperly. Damaged O-ring.
	No Bleed	Foreign objects in fluid. Bleed adjustment set improperly.
	Miscellaneous	Hardware. Improper installation. Improper handling or abuse. Misapplication. Overload. Vibration or wear.

APPENDIX C
(Page 1 of 5)

WYLE LABORATORIES PROCEDURE FOR IN-PLACE HYDRAULIC SNUBBER TESTING USING THE API TEST SYSTEM

1.0 PURPOSE

The purpose of this procedure is to define the methods by which hydraulic snubbers may be subjected to performance tests using the Asmundson-Potter, Inc. (API) In-Place Test System.

2.0 SCOPE

This procedure applies to functional testing to determine the operability of hydraulic snubbers which are generally classified as large bore hydraulic snubbers.

3.0 DESCRIPTION

Hydraulic snubbers are designed to meet two basic requirements. First, they permit essentially resistance-free thermal displacements of pipe and other equipment. Second the snubber acts as a high stiffness member if the pipe or other equipment experiences a sudden high velocity such as that during a seismic occurrence. By design, when the snubber is subjected to a seismic occurrence, the snubber "locks up" or is "activated", thus limiting the velocity to a predetermined level. After "lock up", the snubber continues to "bleed" under a maintained load. Functional examination tests to be performed and acceptance criteria for each will be specified by the client, to determine the operability of the components being tested.

4.0 REFERENCES

4.1 API In-Place Test System Operating and Maintenance Manual

4.2 Wyle Laboratories' Safety Procedures

4.3 Customer's Purchase Order, Job Order, or contract

4.4 Customers Test Specification and Acceptance Criteria

5.0 PREREQUISITES

Prior to commencing functional test activities, the Wyle Site Supervisor or his designee will verify that the following have been completed:

5.1 A Job Order or equivalent work authorization document has been issued.

5.2 The Q.A./Q.C. Department has been notified of the testing schedule.

APPENDIX C
(Page 2 of 5)

WYLE LABORATORIES PROCEDURE FOR IN-PLACE HYDRAULIC SNUBBER TESTING USING THE API TEST SYSTEM

5.3 Appropriate documentation has identified snubbers to be tested.

5.4 All measurements and tests shall be performed at existing ambient conditions.

5.5 All instrumentation, measuring, and test equipment used in the performance of the test procedure shall be calibrated in accordance with Wyle Laboratories' Quality Assurance Program and reviewed by Browns Ferry M&TE Group, prior to use.

5.6 All test deficiencies shall be reported in accordance with Browns Ferry procedure SPP-8.1, with any non-conforming results being processed in accordance with Browns Ferry procedure SPP-3.1.

6.0 PRECAUTIONS

6.1 Observe safe radiological work practices.

7.0 TEST REQUIREMENTS

The test specimens shall be subjected to the following functional tests, as required. Test sequence may be varied as required to satisfy specific test situations. Test results shall be recorded on Attachment 2.

7.1 All acceptance criteria are listed in Section 6.0 of the procedure.

8.0 TEST INSTRUCTIONS

8.1 Pre-Test Set-Up

The test machine requires a 440/480, 3-phase, 30amp power source. Switch the computer, data acquisition and instrumentation electronics to their "on" positions, and respond to all computer prompts to perform a system "self-test". Following a 30 minute warm-up, perform the prefill procedure to purge all hoses. Connect all hydraulic hoses properly and verify that all connectors are secure. Verify that you have flow, using the pre fill procedure and continue for 30 seconds. This setup is required at the beginning of each day.

A calibration check may be performed prior to starting testing and after testing is complete, to verify accuracy of the system.

APPENDIX C

WYLE LABORATORIES PROCEDURE FOR IN-PLACE HYDRAULIC SNUBBER TESTING USING THE API TEST SYSTEM

8.2 Snubber Unpinning Requirements

Unpin the snubber in accordance with MPI-0-000-SNB004.

8.3 Connections

The test machine shall be prepared and connected to access ports on both the tension and compression sides of the hydraulic cylinder within the high pressure boundaries of the snubber to be tested.

To do so, isolate the snubber's fluid reservoir, then remove the test access port plugs from the access ports and install quick disconnect fittings with adapters, as required. Take care to prevent contamination of snubber fluid and internals. Measure and record the pin-to-pin dimension of the snubber. Remove either or both snubber pins from their structural disconnect. Lift or lower the unpinned end of the snubber such that the full stroke of the snubber can be achieved without interference with existing structures. If movement is restricted with 1 pin, remove snubber per MPI-0-000-SNB004 for testing.

8.4 Visual Observation

The test specimen shall be visually observed during all testing for anomalous conditions, such as, fluid leakage, erratic motion, binding, and low fluid level. Retest is allowed if any data is in question.

8.5 Drag/Binding Force

The hydraulic hoses from the instrumentation box shall be connected to the snubber's access ports and the snubber pressurized to allow it to be stroked at an approximately constant low velocity (lower than lockup) and observed for binding. The specimen shall be fully stroked in tension and compression and the drag or binding forces recorded.

8.6 Lockup Velocity Test

Once it has been verified that the piston has reached the end of its stroke, flow shall be increased at a constant rate until lockup occurs. Lockup velocities in both tension and compression shall be recorded. Lockup is defined as the velocity at which the snubber's control valve activates, allowing the snubber to perform its restraining function.

WYLE LABORATORIES PROCEDURE FOR IN-PLACE HYDRAULIC SNUBBER TESTING USING THE API TEST SYSTEM

8.7 Bleed Velocity Test

Following lockup, the pressure shall be increased to the equivalent of the snubber's full rated load (or other specified load) for the bleed rate test. Bleed velocity in both tension and compression shall be recorded. Bleed rate is defined as the snubber velocity that occurs after lockup under maintained load.

8.8 Post-Test Requirements

Upon completion of testing, if snubber installation is required, hoist or lower the snubber into position and if both ends have been unpinned, install one pin. Using the API test machine, "jog" or position the piston until the piston rod eye pinhole is aligned with the structural clevis pinhole and install the second snubber pin.

Remove connecting hoses and quick disconnects. Ensure that snubber ports are completely filled with hydraulic fluid. Reinstall the test access port plugs and torque per drawing requirements.

Ensure snubber reservoir fluid is at the proper level.

9.0 DOCUMENTATION

All of the testing will be performed by Wyle and documented on their forms, but the final results will be documented on Attachment 2 of this procedure.

9.1 Test Log

A test Log shall be maintained to provide a daily description of the testing performed and other significant information regarding specimen status not otherwise recorded.

9.2 Hydraulic Snubber Control Cards/Individual Snubber Data Sheet.

Test information, Notice of Anomaly (NOA) numbers (if required), test results, and pertinent information shall be recorded on the Hydraulic Snubber Control Card or in the format as required by the customer.

9.3 The functional testing of snubbers will be complete when the documentation for each snubber is complete and the snubber is released for disposition.

APPENDIX C
(Page 5 of 5)

WYLE LABORATORIES PROCEDURE FOR IN-PLACE HYDRAULIC SNUBBER TESTING USING THE API TEST SYSTEM

9.4 The Wyle Site Supervisor or his designee will verify that the test prerequisites, test data, and the test results are complete. The Test Log shall reflect the work status.

9.5 Preliminary Test Results

Preliminary test results of the work performed at a customer's site may be communicated either verbally or in writing utilizing copies of the Hydraulic Snubber Control Cards and Computer Data Sheets.

9.6 Certification Test Report

Final test results shall be presented in a Certification Test Report, in accordance with contract terms and conditions. This report shall consist of:

Inspections, observations, and work performed.

Instrumentation Equipment Sheet(s)

Notices of Anomaly (if applicable)

Certificates of Conformance (if required by the Purchase Order).

ATTACHMENT 1
(Page 1 of 1)

SURVEILLANCE INSTRUCTION REVIEW FORM

REASON FOR TEST:
____ Scheduled Surveillance
____ System Inoperable (Explain in Remarks)
____ Maintenance (WO# ______________)
____ Other (Explain in Remarks)

PLANT MODE 1 2 3 4 5 (CIRCLE APPROPRIATE MODE)
MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING

W.O. No.______________ Snubber UNID No.__________________ Serial No. ________

PRE-TEST REMARKS: ____

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)
________	________________	________________
________	________________	________________
________	________________	________________

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is not Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted __________ Date______ Time ______

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored ________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted __________ Date______ Time ______

===

MECHANICAL MAINTENANCE REVIEWER - ____________________ Date ____________

===

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/
SITE CIVIL ENGINEERING REVIEWER - ____________________ Date________

===

SCHEDULING COORDINATOR - ________________________ Date ____________

===

POST-TEST REMARKS: ________________________________ FREQ -
________________________________ FREQ IN RO -
________________________________ KEY - 395

ATTACHMENT 2
(Page 1 of 4)
AS-FOUND TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number:______________________ Date:____________
System Number:______________________ Exam Number:______________________
Snubber UNID Number:______________________ Snubber Rated Load:______________
Serial Number:______________________

	Activation (in/min)	Acceptance Criteria	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	________________ SIGNATURE ____________(AC) DATE
	Bleed (in/min)		
Tension Compression	________ ________	Bleed takes place after snubber activation	________________ SIGNATURE ____________(AC) DATE
	Load(lbs)		
Tension		None	________________ SIGNATURE ________________ DATE
Compression			
	Drag(lbs)	MAXIMUM 15,000 POUNDS	________________ SIGNATURE ____________(AC) DATE
Tension Max: Avg: Compression Max: Avg:	 ________ ________ ________ ________		
Copy of the plotted As-Found test results is attached to this data sheet.			____________/______ INITIALS DATE

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Found test acceptance criteria: ____ Yes ____ No

If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

______________________________/________
SNUBBER ENGINEER/SE DESIGNEE Date

ATTACHMENT 2
(Page 2 of 4)
AS-LEFT TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number: ________________ Date:______________
System Number:______________________ Exam Number:______________________
Snubber UNID Number:________________ Snubber Rated Load:________________
Serial Number:______________________

	Activation (in/min)	Acceptance Criteria	Performer Signature/ Date
Tension Compression	_________ _________	6 in/min ≤ Activation ≤ 25 in/min	____________________ SIGNATURE _______________(AC) DATE
	Bleed (in/min)		
Tension Compression	_________ _________	Bleed takes place after snubber activation and shall be within the range 1 in/min to 10 in/min	____________________ SIGNATURE _______________(AC) DATE
	Load(lbs)		
Tension		None	____________________ SIGNATURE ____________________ DATE
Compression			
	Drag(lbs)		
Tension Max: Avg: Compression Max: Avg:	 _________ _________ _________ _________	MAXIMUM 15,000 POUNDS	____________________ SIGNATURE _______________(AC) DATE
Copy of the plotted As-Left test results is attached to this data sheet.			____________/_______ INITIALS DATE

* Case specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Left test acceptance criteria: ____ Yes ____ No

If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

______________________________/________
SNUBBER ENGINEER/SE DESIGNEE Date

ATTACHMENT 2
(Page 3 of 4)

REMOVAL AND REINSTALLATION OF BERGEN PATERSON
TORUS DYNAMIC RESTRAINTS

W. O. No. __________________ Unit __ Snubber UNID No. ____________________

Serial No. __________ Subgroup ________ Test Lot: Initial ____ Subsequent ____

Exam No. ______ Size ______ Rated Load __________lbs.

Design drawing number ______________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of snubber for functional testing.

____________________________ ___________ __________
Foreman/Designee Date Time

As-Found Stroke Setting _______

Required Stroke Setting Range _______
(from Design drawing)

The As-Found Stroke Setting is within the acceptable limits shown in the design drawing listed above.

______ Yes ________ No ______________________/______(AC)
Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component anchorage).

If the answer is "No", complete Attachment 6.

______ Yes ______ No ______________________/______(AC)
Performer Signature Date

Review test data for acceptability. If the test results are unacceptable, specify the action to be taken: ____
____
____
____

______________________________/______
Snubber Engineer/SE Designee Date

ATTACHMENT 2
(Page 4 of 4)

W. O. No. ____________________ Unit __ Snubber UNID No. ______________

Snubber reinstallation:

Same snubber reinstalled	____Yes	____No	
If No, enter Lisega TDR serial number			
	__________ Serial Number (Lisega TDR)		
Snubber is reinstalled in proper location	____Yes	____No	
Snubber is reinstalled with base of housing up	____Yes	____No	
All locking devices are secured	____Yes	____No	
Cotter pins are spread	____Yes	____No	___N/A
Spherical bearing greased	____Yes	____No	___N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	____Yes	____No	
Snubber is tagged	____Yes	____No	
Bolts and jam nuts torqued	____Yes	____No	___N/A
Anti-seize compound applied, as needed	____Yes	____No	___N/A

Torque Wrench No. ____________
Calibration Due Date __________
As-Left Stroke Setting _______

____________________/________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the design drawing.
______ Yes _______ No

____________________/________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

____________________/________
Foreman/Designee Date

Remarks: ____
____
____

ATTACHMENT 3
(Page 1 of 2)

ENGINEERING FAILURE ANALYSIS FOR INOPERABLE SNUBBERS

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ PER No. _________________ Mfg./Size __________________________

Serial No. ________ Rated Load __________ Exam No. _____ Lot _____

1. Describe the mode of failure as discussed on Appendix B.

   ☐ Locked up ☐ High Drag Force
   ☐ Snubber would not activate ☐ Damage to snubber hardware

   Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of the failure, using Appendix B for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release or is locked up, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No

   Explain evaluation:

ATTACHMENT 3
(Page 2 of 2)

ENGINEERING FAILURE ANALYSIS FOR INOPERABLE SNUBBERS

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ PER No. _________________ Mfg./Size __________________________

Serial No. ________ Rated Load ___________ Exam No. _____ Lot _____

5. Was the snubber failure attributed to its location? ☐ Yes ☐ No

   Explain:

6. Does the vendor need to be contacted? ☐ Yes ☐ No
   Vendor Name:
   Person contacted: Date: Vendor's comments:

7. What subsequent testing is required because of this failure?

   Subsequent Lot No. No. of snubbers to be tested

8. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ________________________________/_________
Snubber Engineer/SE Designee Date

ATTACHMENT 4
(Page 1 of 1)

SUPPORTED SYSTEM/COMPONENT ANALYSIS FOR INOPERABLE SNUBBERS

WO No. ____________ Unit _ Snubber UNID No. ______________

Subgroup No. _____ PER No. ______________ Mfg./Size ______________________

Serial No. _______ Rated Load _________ Exam No. _____

1. Describe the condition(s) (e.g., snubber would not activate, was locked up, or had excessive drag force, etc.).

2. Attach the SE evaluation of the attached component:

3. Based on the results of the Engineering evaluation, has the snubber failure mode adversely affected the supported system or component?

__________________________/_________

Snubber Engineer/SE Designee Date

ATTACHMENT 5
(Page 1 of 1)

CASE SPECIFIC ACCEPTANCE CRITERIA

WO No. ____________ Unit _ Snubber UNID No. _______________

Subgroup No. _____ PER No. _______________ Mfg./Size _______________________

Serial No. ________ Rated Load __________ Exam No. _____

1. Describe the standard acceptance criteria:

   ☐ As-Found ☐ As-Left

2. Record the parameter(i.e., actuation, bleed, drag) and the test results that are outside the standard acceptance criteria:

   ☐ As-Found ☐ As-Left

3. Specify the case specific Acceptance Criteria and provide justification.

________________________/________

Site Engineering Civil Date

ATTACHMENT 6
(Page 1 of 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners, used for attachment of snubber to component, and to snubber anchorage, are discovered loose or missing prior to the As-Found functional testing.

W.O. No. ________________ Unit __ Date Discovered ____________

Snubber UNID No. ________________ Serial No. _______ Subgroup ________

Exam No. _______ Size _______ Rated Load _________ Lbs. Pipe Size ______

1. Describe the discovered condition(s) and if possible, determine cause:

2. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.:

Evaluated by: ________________ / ________
Date

3. Describe the corrective action(s) and provide the As-Found test result.

Evaluated by: ________________ / ________
Date

4. Conclusion: Is the snubber operable?

Justification:

Evaluated by: ________________ / ________
Date

Attachment F

BFN SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2E,

Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

SURVEILLANCE INSTRUCTION

0-SI-4.6.H-2E

FUNCTIONAL TESTING OF LISEGA LARGE BORE TORUS DYNAMIC RESTRAINT SNUBBERS

REVISION 4

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Description of Change: IC-06

This procedure is being revised to clearly define acceptance criteria; incorporate changes in status check step during warm-up period in Appendix C; updated Table A-1 to account for total Lisega Torus Dynamic Restraints in Unit 2 and 3; incorporate changes on Attachment 1 to ensure snubber operability checks and sign-off; incorporate changes to reflect acceptance criteria checks, test performer signatures, Foreman/Designee sign-off, and deleted second party sign-off in Attachment 2; incorporate minor changes in Attachment 3, 4, 5, and 6; and correct minor typographical errors.

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1.0 INTRODUCTION

1.1 Purpose

This Surveillance Instruction implements Technical Requirements Manual (TRM) TR 3.7.4, and provides direction for the functional testing, of Lisega Large Bore Torus Dynamic Restraints, as given in the Snubber Program Procedure (0-TI-398).

1.2 Scope

NOTE:

1. For the purposes of this instruction, the snubbers are categorized into two major groups, based on whether the snubbers are accessible or inaccessible during reactor operation. These major groups may further be divided into subgroups based on design of the snubbers or may be established by engineering analysis based on environment or other failures which may be expected to affect the operability of the snubbers within the group.
2. The terms group or category may be used interchangeably throughout this instruction.
3. The remaining portions of Technical Requirements TR 3.7.4 pertains to the visual examination of snubbers and is implemented by Surveillance Instruction 2-SI-4.6.H-1 and 3-SI-4.6.H-1.

1.2.1 Guidance to Perform the Functional Test

This Surveillance Instruction (SI) provides the requirements and guidance to perform functional testing of Lisega Torus Dynamic Restraints for Units 2 and 3, and may use a Lisega Surrogate as follows:

- Removal and reinstallation of Lisega Torus Dynamic Restraints is accomplished per MPI-0-000-SNB004 and recorded in Attachment 2.
- Provides the requirements for functional testing and service life monitoring of Lisega Torus Dynamic Restraints. This instruction covers subgroup 5 only (see Appendix A for snubber subgroup information). To completely fulfill the snubber Technical Requirements (TR) functional testing requirements, other Surveillance Instructions 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, and 0-SI-4.6.H-2C must also be performed.
- Provides guidance in the operation of the snubber test equipment.
- Provides a means for the control and documentation of all Lisega Torus Dynamic Restraint snubber surveillance activities provided in this Surveillance Instruction.
- This Surveillance Instruction shall be used to verify operability of Lisega Torus Dynamic Restraint snubbers suspected inoperable during performance of the visual examination SIs.

1.3 Frequency/Conditions

1.3.1 This Surveillance Instruction shall be performed each refueling outage and portions of it may be performed to establish operability in accordance with 2-SI-4.6.H-1, 3-SI-4.6.H-1 Visual Examination of Hydraulic and Mechanical Snubbers.

1.3.2 This instruction should only be performed during an outage for the Lisega Large Bore Torus Dynamic Restraints.

1.3.3 All safety related snubbers shall be operable during all modes of operation as described in the Technical Requirements Manual TR 3.7.4, if the system is required to be operable during that mode.

1.3.4 Snubbers on safety related systems that have experienced unexpected potentially damaging transients shall be evaluated for the possibility of concealed damage and functionally tested, if applicable.

1.3.5 A snubber removed from an operable safety related system must be reinstalled or replaced within 72 hours of its removal or declare the supported system/component inoperable and follow the appropriate action statement for that system.

1.3.6 For inoperable snubber(s), within 72 hours, replace or restore inoperable snubber(s) to an operable status and perform an engineering evaluation on the supported component or system, if the snubber does not meet the functional test acceptance criteria of TSR 3.7.4.2. Otherwise, declare the system inoperable and follow the required actions specified in the TRM. The engineering evaluation is to determine if component or system restrained by the snubber(s) was adversely affected by inoperability of the snubber(s) during the previous operating cycle and ensure that the restrained component or system remains capable of meeting their design function. The engineering evaluation(s) for supported component or system analysis are to be recorded on Attachment 4.

1.3.7 Snubbers removed for maintenance or determined to be inoperable on a non-operable safety related system must be reinstalled or replaced, in accordance with MPI-0-000-SNB004 and tested in accordance with this instruction, prior to declaring the system operable.

1.3.8 For all subgroups, when subsequent testing is required, it shall continue within the respective subgroup until no failure is found, or all snubbers in that subgroup have been tested, or all suspect snubbers identified by the failure analysis have been tested. The failure analysis shall be used, as applicable, in selecting snubbers to be tested in the subsequent lot in an effort to determine the OPERABILITY of other snubbers that may also be subject to the same failure mode.

1.3.9 New, replaced, or rebuilt snubber(s) shall meet the functional test acceptance criteria before their installation in the unit and must have been functionally tested "Satisfactory", within 12 months prior to their installation.

2.0 REFERENCES

2.1 Technical Requirements Manual TR 3.7.4, Snubbers.

2.2 2-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.3 3-SI-4.6.H-1, Surveillance Instruction Visual Examination of Hydraulic and Mechanical Snubbers.

2.4 MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers.

2.5 BFN-VTM-L329-0010, Vendor Technical Manual for Lisega Torus Dynamic Restraint Snubbers.

2.6 BFN-VTD-L329-0070, Installation and Maintenance Instruction for Lisega Type 31 21 50 and Test (Surrogate) Type 31 Hydraulic Shock Absorber.

2.7 PE-8997-P1, Special 4 Inch Tapered Pin Installation and Removal Procedure.

2.8 0-TI-398, Snubber Program Procedure

2.9 SPP-3.1, Corrective Action Program

2.10 SPP-8.1, Conduct of Testing.

3.0 PRECAUTIONS AND LIMITATIONS

NONE

4.0 PREREQUISITES

4.1 Six months prior to each refueling outage, ensure a minimum of 10% of the new Lisega Torus Dynamic Restraint snubbers have been tested and are ready for installation, if required. No paperwork is required, since these snubbers are not under the Section XI Repair and Replacement Program.

5.0 SPECIAL TOOLS AND EQUIPMENT RECOMMENDED

DESCRIPTION	SIZE	QUANTITY
5.1 AP 280 (Lisega Spec. No. 151)		As required
5.2 Snubber Test Machine	As required	1

6.0 ACCEPTANCE CRITERIA

6.1 Responses which fail to meet the following acceptance criteria require immediate notification of the Snubber Engineer/SE Designee at the time of failure.

6.2 The "As-Found" functional test shall verify that:

6.2.1 Activation is achieved, in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

NOTE:

For As-Found testing the only requirement for the bleed rate is that there is bleed after the snubber activates.

6.2.2 Bleed shall take place after activation of the snubber, in both tension and compression.

6.2.3 Drag forces shall be less than or equal to 15,000 pounds.

6.2.4 Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.3 The "As-Left" functional test shall verify that:

6.3.1 Activation is achieved, in both directions of travel at a piston velocity greater than or equal 6 inches/minute and less than or equal 25 inches/minute.

6.3.2 Bleed shall take place after activation of the snubber, in both tension and compression and be greater than 0.28 inch/minute and less than 1.18 inches/minute.

6.3.3 Drag force shall be less than or equal to 15,000 pounds.

6.3.4 Activation, bleed, or drag force acceptance criteria may be other than that described in the steps above, if approved by Site Engineering on Attachment 5.

6.4 The stroke setting shall be within the limits shown in the design drawing.

6.5 There shall be no loose or missing fasteners for attachment of the "As-Found" dynamic restraint(s) to the component or the anchorage. Otherwise, complete Attachment 6.

7.0 PROCEDURE STEPS

7.1 Training and Qualification of Performers

7.1.1 Thorough briefing should be conducted on SI performance prior to starting.

7.1.2 The cognizant individual or Snubber Engineer responsible for the performance of the Surveillance Instruction must be qualified as a test director.

7.1.3 Appropriate General Employee Training (GET) should be received by personnel prior to performing this SI.

7.1.4 Training required for the testing of the Lisega Torus Dynamic Restraint snubbers shall be as required by the Snubber Engineer.

7.2 Preparation of Test Data Package

7.2.1 SELECT snubbers for retest which were placed in the same location as snubbers which failed during the previous outage if the failure analysis showed that the failure was due to the location. However, these snubbers shall be tested in addition to the initial 10 percent test lot (sample plan).

7.2.2 DETERMINE the initial test lot (sample plan) as follows:

- SELECT 10 percent of the snubbers from subgroup 5 (see Appendix A).
- SELECT the snubbers with the most time from the previous test.
- SELECT snubbers that have experienced severe transients.
- SELECT snubbers that leak the most hydraulic fluid.
- SELECT snubber(s) that must be tested per an engineering evaluation, if applicable.
- DO NOT SELECT snubber(s) which failed during the last surveillance test.

7.3 Removal of Valves From Restraint/Surrogate

NOTE:

1. Before the existing valves are removed, record the "As-Found" stroke setting in Attachment 2, and there must be no external forces exerted on the restraint, either in compression or tension.
2. Prior to the removal of the existing valves ensure there are spare valves, on hand, which have been tested and passed their functional test within the past 12 months.
3. For valve removal, always remove the front valve 1st and the rear valve 2nd. For valve installation, always install the rear valve 1st and the front valve 2nd.

7.3 Removal of Valves From Restraint/Surrogate (Continued)

7.3.1 REMOVE the hexagon screw, disk, bushing and lock plate from the face side of the valve body. See Illustration 1.

7.3.2 TURN the 2-way ball valve positioner from the slot being in the vertical to the horizontal direction as shown in position 2, of Illustration 1. This disconnects the snubber main body cylinder from the rear valve.

7.3.3 REMOVE the hex screws from the cover of the front valve. See Illustration 2.

NOTE:

When lifting the valve the automatic shut-off valve between the pressurized reservoir and the restraint body interrupts the connection, so that the cylinder is no longer pressurized.

7.3.4 REMOVE the front cover, then REMOVE the valve with the extraction tool. See Illustration 2.

7.3.5 CONNECT a drain hose to the coupling at the snubber drain port shown in Illustration 3, on the interior face of the valve body.

7.3.6 DRAIN the oil from between the valves. After draining is complete, REMOVE the drain hose.

7.3.7 REMOVE the hex screws from the cover over the rear valve. See Illustration 2

7.3.8 REMOVE the rear cover, then REMOVE the valve with the extraction tool. See Illustration 2.

7.4 Installation of the Valves in the Restraint/Surrogate

NOTE:

1. Prior to installation of the tested valves all O-rings shall be checked and replaced, if necessary.
2. The screws for the valve covers are only to be tightened snug-tight.

7.4.1 ADD AP 280 hydraulic fluid to the hole for the rear valve. The fluid level shall be approximately equal to the level shown in Illustration 4.

7.4.2 INSERT the tested rear valve, then REPLACE the COVER over this valve and SECURE it with the lock washers and screws removed in step 7.3.7. See Illustration 2.

7.4.3 ADD AP 280 hydraulic fluid to the hole for the front valve. The fluid level shall be approximately equal to the level shown in Illustration 4.

7.4.4 ENSURE all of the air in the cross-tie line has been removed.

7.4 Installation of the Valves in the Restraint/Surrogate (Continued)

NOTE:

1. At the installation of the front valve the shut-off valve to the reservoir opens automatically, repressurizing the restraint.

2. The front valve requires sufficient force added to insert it, due to the pressure on the shut-off valve from the reservoir.

7.4.5 INSERT the tested front valve, then REPLACE the cover over this valve and SECURE it with the lock washers and screws removed in step 7.3.3. See Illustration 2.

7.4.6 TURN the 2-way ball valve positioner from the slot being in the horizontal to the vertical direction, as shown in position 1 of Illustration 1. This connects the snubber main body cylinder to the rear valve.

7.4.7 REPLACE the bushing, lock plate and disk. See Illustration 1.

NOTE:

Prior to the performance of the next step, it is required that parts to receive locking fluid (such as Loctite) are free of oil or grease.

7.4.8 APPLY a small amount of locking fluid (such as Loctite) to the threads of the hex screw removed in step 7.3.1.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine

7.5.1 ENSURE the test machine has been warmed up in accordance with Appendix C of this procedure.

NOTE:

The word " Test SNUBBER" as used in this test may imply the Lisega Surrogate Snubber with properly installed valves in accordance with Section 7.4. The following is a suggested procedure for "Testing a Surrogate Snubber" using the STB 200 Snubber Test Machine with the upgraded Windows Software Operations Manual.

7.5.2 **POWERING UP THE TEST SYSTEM**
TURN ON the master power switch on the control console. Make sure that the computer, monitor, and printer are turned on.
TURN ON the main breaker on the Hydraulic Power Unit (HPU) located at the end of the power unit.

ENSURE that all emergency stop buttons are pulled out.

7.5.3 **STARTING THE SOFTWARE**
Once the computer has "Booted Up", the Windows Desktop will be displayed. SELECT the "STB 200" icon and double click on it, this will Start the Test program. The LOG ON prompt window will appear.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Machine (Continued)

7.5.3 **STARTING THE SOFTWARE** (Continued)

ENTER you user name and password in either upper or lower case letters.

All functions required by the system are available in the screen, or from one of the Pull Down Menus at the top of the screen.

7.5.4 **DAILY CALIBRATION CHECK**
PERFORM the daily calibration check, using Section 3 of Appendix C and sign the daily calibration form.

After the daily calibration check has been completed, and the Daily Calibration Report is "SATISFACTORY", proceed on testing a snubber.

7.5.5 **TESTING A SNUBBER**

7.5.5.1 **Pick the Snubber Type**
Using the Snubber Pull Down List in the User Supplied Information block, SELECT the Type Snubber to be tested.

7.5.5.2 **Enter the Header Information**
FILL in the other information as indicated in the User Supplied Information block.

7.5.5.3 **Running the Test**

1. ***Pick the Test***
   CLICK on the Type of Test (i.e., "As-Found" or "As-Left") as desired.

2. ***Start the Test***
   CLICK on the Start Test button. If this is the first test performed on the snubber, the following two windows will appear:

3. ***Tare weight Window***
   This window allows the User to "zero out" any offset load that the load cell may be reading. This should be performed BEFORE installing the snubber in the test bench.
   Wait for the "Raw Reading" to settle (as far as possible), and then Click "Adjust Load Cell". The "Adjustment" will be updated, and the "Adjusted Reading" should now read close to zero (0) lb.
   The "Adjust Load Cell" button may be Clicked again if a new adjustment value is desired.
   Once the readings are as desired, Click the "Continue" button.

   ENSURE the correct load cell is connected to the machine.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.5 **TESTING A SNUBBER** (Continued)

7.5.5.3 **Running the Test** (Continued)

3. ***Tare weight Window*** *(Continued)*

CHOOSE the proper bushings and pins for the snubber being tested, then INSTALL the bushings in both clevis attachments on the machine.

4. ***Stroke and Position Window***

INSTALL the snubber in the test bench, with the piston or operable end toward the drive piston of the machine if possible. Adjust the backstop and or use the Jog Speed Slider to adjust the bench and the driver cylinder to the desired pin to pin dimension. The jog slider adjusts the jog speed. The joystick on the test frame controls the actual motion of the driver.

INSTALL the pins through the bushings and the snubber spherical bearings.

With the surrogate snubber installed in the horizontal position, REMOVE any tested valves from the surrogate snubber using the steps in Section 7.3, as appropriate.

Note:
A small amount of AP 280 Silicon hydraulic fluid may have to be added to the hole for the front valve. The oil level should be approximately at the upper edge of the connection bore between the front and rear valve. This can also be accomplished by opening the shut-off-valve by hand.

INSERT the valves removed from the existing restraint to be tested, using the steps in Section 7.4, as appropriate.

ONCE the snubber has been pinned and the valves installed, the snubber's piston position (distance from the fully retracted position) should be accurately measured (within 0.1 inch) and entered in the SNUBBER EXTENSION window.

If the test program calculates that it cannot fully extend or fully retract the snubber during drag testing, one or more of the text windows on the screen will be highlighted in red. If this happens, the backstop will have to be adjusted and the snubber extension recalculated.

The program calculates whether it can fully test the snubber through its stroke range. It will display the two ends of

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.5 **TESTING A SNUBBER** (Continued)

7.5.5.3 **Running the Test** (Continued)

4. ***Stroke and Position Window*** *(Continued)*

stroke (minus a 1/2 inch safety zones), the calculated center position and the bottomed out position for the snubber.

Once the data has been successfully entered, TIGHTEN the lock nuts on the load cell threaded rod snug tight to prevent slippage during the test.

ENTER the snubber UNID number, WO number, system number, serial number, and test equipment information on Attachment 2 as required, and Click on "Continue with Test" to continue the test.

5. ***If an Activation Test is Selected***

After all the above steps have been completed, and PRIOR to starting the test (i.e., "As-Found" Activation Test), the test program will initiate a routine to set and stabilize the hydraulic system pressure at a calculated level sufficient to achieve the requested test load. During this period, the setpoint and actual pressures are displayed, along with the output voltage, and a "count down" value. When the pressure is near the desired value, the countdown value will decrement towards zero. If the pressure fluctuates out of limits, the countdown will reset to six. Once the pressure is stable enough to let the countdown complete, the test will begin automatically.

- OBSERVE that the snubber activates in both directions to establish operability of the snubber in the "As-Found" condition.

- RECORD all necessary information on Attachment 2, as appropriate.

If the user wishes to force a test, clicking the "Force the Test" button will initiate the test regardless of pressure.

NOTE: Forcing a test may allow the machine to overstress the snubber during the test!.

Clicking the "Abort the Test" button will cause the test cycle to abort without performing the test.

6. ***If Drag Test is Selected***

If a Drag Test (i.e., **ID**, **AC**, and **FD** test sequence for "As-Left", and **AC**, **FD** test sequence for "As-Found" test) is selected, the test system will automatically begin the drag

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.5 **TESTING A SNUBBER** (Continued)

7.5.5.3 **Running the Test** (Continued)

6. ***If Drag Test is Selected*** *(Continued)*

test. The system will determine the starting position of the snubber, and choose the initial test direction to move towards the farthest end of stroke. The drag speed will be automatically controlled to the target speed set earlier. This test is to VERIFY free travel of the piston rod through its full stroke. The Raw Test Data graphed in real time is reviewed to:

- VERIFY that freedom of movement is not restricted, and drag forces of the snubber is less than or equal to 15,000 pounds.

- RECORD this information on Attachment 2, as appropriate.

7. ***Printing the Results***

After the test on the surrogate snubber is complete, the calculations appropriate to that test are performed and the results are displayed on the screen.
This allows the user to review and determine if the "As-Found" test results meets the "As-Found" acceptance criteria in Section 6.2, or Section 6.3 for the "As-Left" test, and plot the test results.

For Activation tests on acceleration limiting snubbers only, the calculated acceleration lines will be printed if they are displayed on the graph when printing is requested.

- If the results are within the acceptance range for the type of test performed, then Click on the "Print Test" button to open the standard Windows printer dialog box. SELECT the proper printer, and Click "OK" to start the printing.

- ATTACH the Printed Results of the surrogate snubber tests in Attachment 2, as part of the work package.
  CONVERT the surrogate snubber test results to the Lisega Large Bore (Type 31 21 50) values, using the conversion factors and nomenclature in Attachment 2.
  VERIFY that the converted values meets the acceptance criteria, and RECORD in Attachment 2.

- If the test results are not within acceptable range, DO NOT start printing or saving the test results. Proceed to Step 7.5.9 below.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.5 **TESTING A SNUBBER** (Continued)

7.5.5.3 **Running the Test** (Continued)

8. ***Saving the Test Results***
To save a test file to disk, click the "Save Test" button. This saves the test results in the "test_data" directory. The file name of the saved test result is as follows:
Work_Order_number Serial_number Test_Date Test_Type.csv

Where:
Work_Order_number is the value entered in the work order number entry
Serial_number is the value entered in the serial number entry
Test_Date is the date when test was performed
Test_Type is **ID** for initial drag tests, **AC** for activation tests and **FD** for final drag tests.
Tests are saved as comma separated variable files and may be directly loaded into Excel or similar spreadsheet programs as desired.

9. ***Running Another Test***
Click on the Type of test to be performed. The results of the last test will be erased, and the graph will rescale for the test to be done.

- REPEAT the procedure from Step 7.5.5.3.2. to complete Running Another Test (i.e., the "As-Left"), as needed.

10. ***Testing Another Snubber***
Select a new snubber type, if necessary, from the snubber pull down list. If a snubber of the same type is to be tested, the user has to only change the serial number, hanger number, and work order entries.

- REPEAT this procedure from Step 7.5.5.3.1. to complete Testing Another Snubber.

7.5.5.4 **Quitting and Shutting Down the System**
TURN OFF the 480Vac power on the HPU. On the computer screen, Select EXIT from the File Menu. When the Windows screen appears, Click on START, then SHUTDOWN, and click on Shut down the Computer. Then click OK.
When the computer has completely shutdown, TURN OFF the main power switch on the current control consoles.

Reminder: Do not shutdown the console power without exiting Windows properly.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.5 **TESTING A SNUBBER** (Continued)

7.5.5.4 **Quitting and Shutting Down the System** (Continued)

NOTE:
At this time the machine has completed Running the Test. Unless you are leaving the building, leave the machine running so it will not have to be warmed up to perform another test (i.e., the "As-Left" test as needed).

7.5.6 DETERMINE if the "As-Found" test result values as CONVERTED for the Lisega Large Bore snubber (Type 31 21 50) meets the acceptance criteria in Section 6.2.

7.5.7 If the CONVERTED test result values for the Lisega Large Bore snubber (Type 31 21 50) meets the acceptance criteria, then ENTER the information on Attachment 2, and STORE the tested valves until needed.

7.5.8 If the CONVERTED test result values meet the "As-Left" acceptance criteria in Section 6.3, then ENTER the information on Attachment 2.

7.5.9 If the CONVERTED test result values fail to meet the functional test criteria, PERFORM the following:

- NOTIFY the Snubber Engineer/SE Designee for determination of further actions.
- REQUEST a Case Specific Acceptance Criteria Evaluation using Attachment 5.
- REQUEST a failure analysis on Attachment 3 and a supported component or system analysis on Attachment 4, as necessary.

7.5.10 DETERMINE the subsequent test lot (sample plan), as required.

7.5.11 SELECT the number of restraints equal to 10 percent of the remaining restraints in that subgroup.

7.5.12 SELECT snubbers that leak the most time from previous test.

7.5.13 SELECT the restraints with the most time from the previous test.

7.5.14 SELECT snubbers that must be tested per an engineering evaluation, if applicable.

7.5.15 DO NOT SELECT snubbers which failed during the last surveillance test.

7.5.16 FILL OUT ALL applicable sections of Attachment 2, as required.

7.5.17 SELECT snubbers that have experience severe transients.

7.5 "As-Found" and "As-Left" Functional Test Using STB-200 Test Bench (Continued)

7.5.18 ENSURE test data package is ready for Shift Manager/Unit Supervisor authorization.

7.5.19 PERFORM Section 7.5 for the subsequent test lot (sample plan).

7.6 Results Evaluation

NOTE:
The following reviews are usually performed by the Snubber Engineer/SE Designee, or a Site Engineering Civil representative:

7.6.1 COMPARE the As-Found and As-Left test results on Attachment 2 to the acceptance criteria given in Section 6.2 and 6.3. If the As-Found or As-Left test results exceeds the allowable for activation, bleed, and drag force, perform a case specific evaluation on Attachment 5, as necessary.

7.6.2 REVIEW all of the test data on Attachment 2.

7.6.3 If any snubber is determined to not meet the As-Found acceptance criteria:

- NOTIFY the Shift Manager/Unit Supervisor of the inoperable snubber.
- INITIATE a PER in accordance with SPP-8.1 and SPP-3.1.
- INITIATE a WO to replace or rebuild the snubber, if necessary.
- PERFORM the supported system or component evaluation on Attachment 4.
- PERFORM a failure evaluation of any inoperable snubber and DOCUMENT on Attachment 3.
- SELECT the subsequent test lot (sample plan).

7.7 Data Sheet Review

7.7.1 VERIFY the WO has been initiated to remove existing valves, replace with valves functionally tested "Satisfactory", and ENTER in the Remarks section of Attachment 2.

7.7.2 VERIFY that all applicable Attachments are completed for the snubbers tested.

7.7.3 VERIFY failure analysis of failed snubber has been performed in accordance with Attachment 3.

7.7.4 REVIEW the SE evaluation of the supported system or component analysis Attachment 4, if applicable.

7.7 Data Sheet Review (Continued)

7.7.5 VERIFY the Snubber Engineer/SE Designee has reviewed all of the necessary attachments and all acceptance criteria have been met.

7.7.6 REVIEW the completed SI package for final acceptance.

NOTE:
Computer generated data sheets containing information regarding the initial test log, subsequent test logs, rebuild, etc., should be submitted with the SI data package.

7.7.7 SUBMIT the completed data package for closure.

8.0 ILLUSTRATIONS/APPENDIX/ATTACHMENTS

Illustration 1 - Two Way Ball Valve Locations and Positions
Illustration 2 - Cover and Valve Removal and Reinstallation
Illustration 3 - Drain Hose Connection
Illustration 4 - Oil Level in Valve Hole Prior to Replacing the Removed Valve
Illustration 5 - Fluid Level in Surrogate Test Snubber Holes
Illustration 6 - Lisega Fluid Level Measurement of Surrogate Test Snubber
Illustration 7 - Lisega Piston Position Measurement
Illustration 8 - Lisega Minimum Fluid Level Plunger and Piston Measurement in the Field

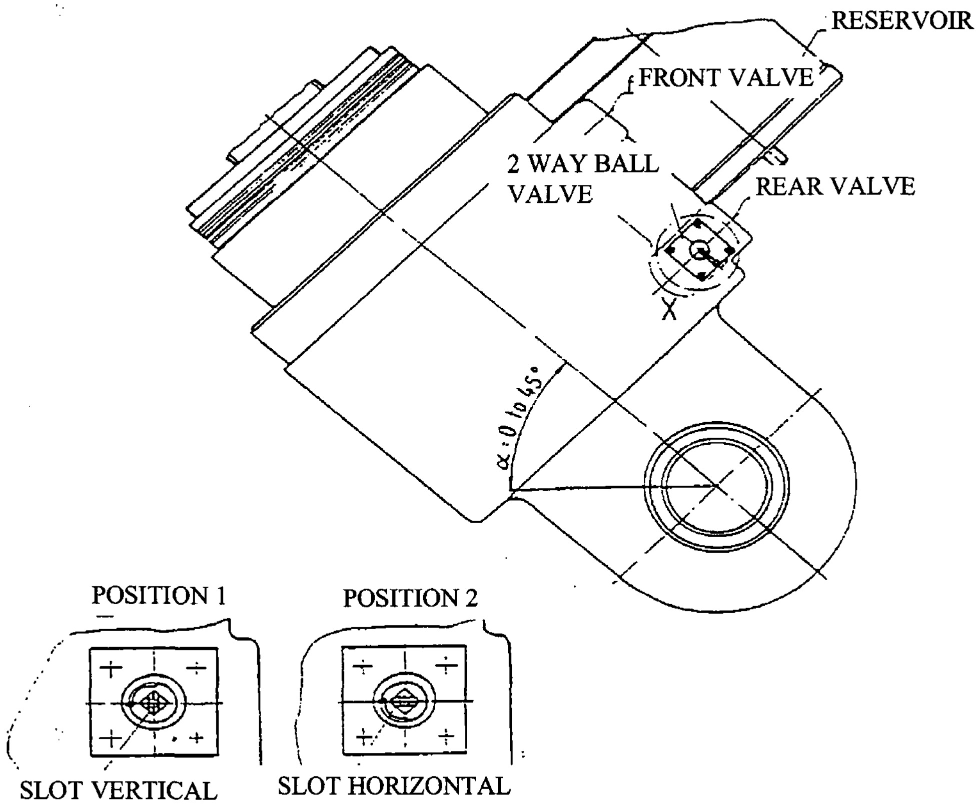
Appendix A - Subgrouping and Service Life Monitoring of Snubbers
Appendix B - Common Modes of Snubber Failure and Possible Causes
Appendix C - Daily Startup Procedure for the STB-200 Test Bench

Attachment 1 - Surveillance Instruction Review Form
Attachment 2 - Nomenclature, Conversion, As-Found and As-Left Test Data, Removal and Reinstallation Data Sheets for Lisega Large Bore Torus Dynamic Restraints
Attachment 3 - Engineering Failure Analysis for Inoperable Snubbers
Attachment 4 - Supported Component or System Analysis for Inoperable Snubbers
Attachment 5 - Case Specific Acceptance Criteria
Attachment 6 - Evaluation of Loose or Missing Attachment Fasteners

END OF TEXT

ILLUSTRATION 1
(Page 1 of 1)

TWO WAY BALL VALVE LOCATION AND POSITION



2 WAY BALL VALVE

ILLUSTRATION 2
(Page 1 of 1)

Cover and valve Removal and Reinstallation

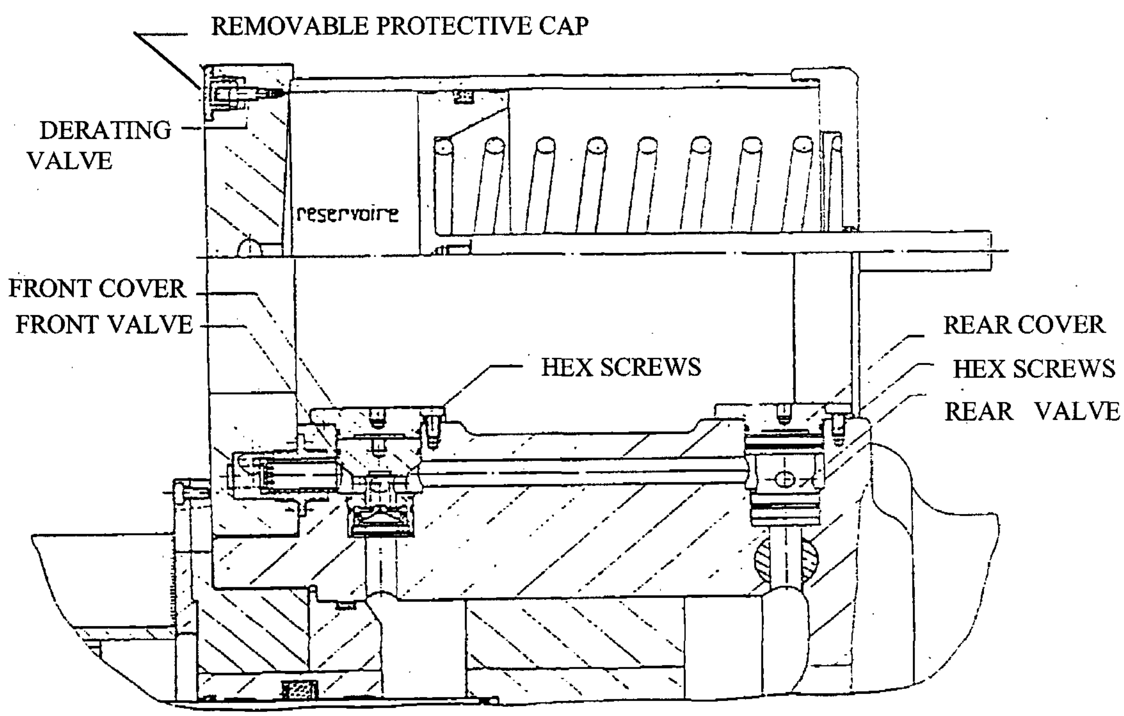


ILLUSTRATION 3
(Page 1 of 1)

DRAIN HOSE CONNECTION

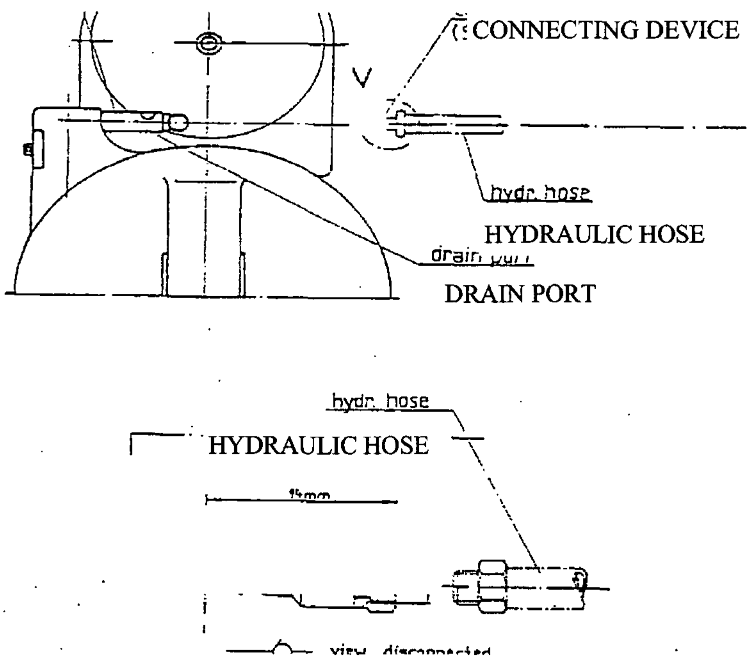
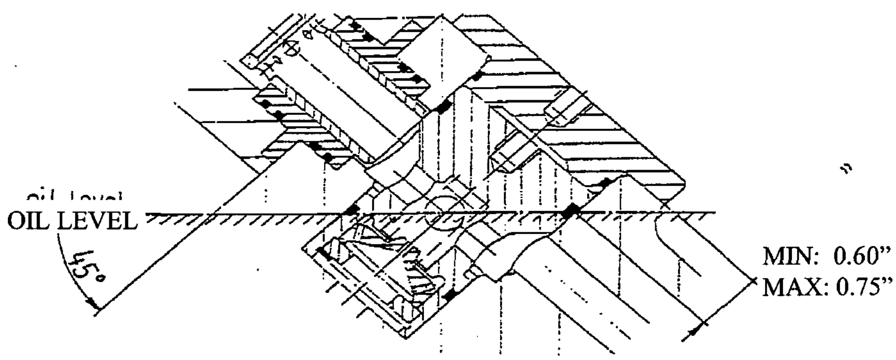


ILLUSTRATION 4
(Page 1 of 1)

OIL LEVEL IN VALVE HOLE PRIOR TO REPLACING THE REMOVED VALVE

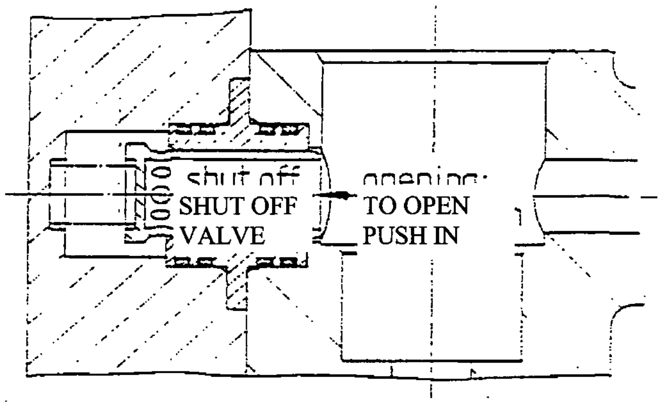


igure 2: Oil level in front valve before replacing the removed valve

OIL LEVEL IN FRONT VALVE BEFORE REPLACING THE REMOVED VALVE.
(OIL LEVEL IN REAR VALVE IS SAME AS IN FRONT VALVE

ILLUSTRATION 5
(Page 1 of 1)

FLUID LEVEL IN SURROGATE TEST SNUBBER HOLES



OIL LEVEL SHOULD BE AT THE UPPER EDGE OF THE CONNECTION BORE BETWEEN THE FRONT AND REAR VALVE

ILLUSTRATION 6
(Page 1 of 1)

LISEGA FLUID LEVEL MEASUREMENT
OF SURROGATE TEST SNUBBER

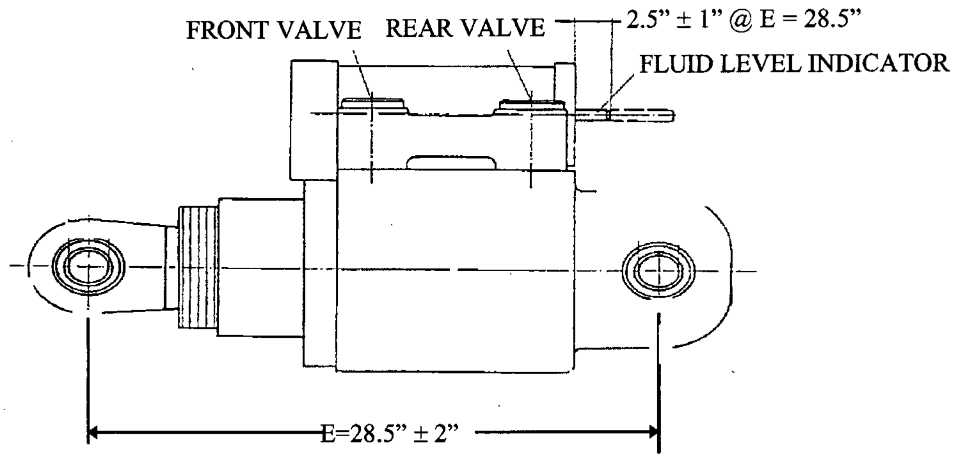


ILLUSTRATION 7
(Page 1 of 1)

LISEGA PISTON POSITION MEASUREMENT

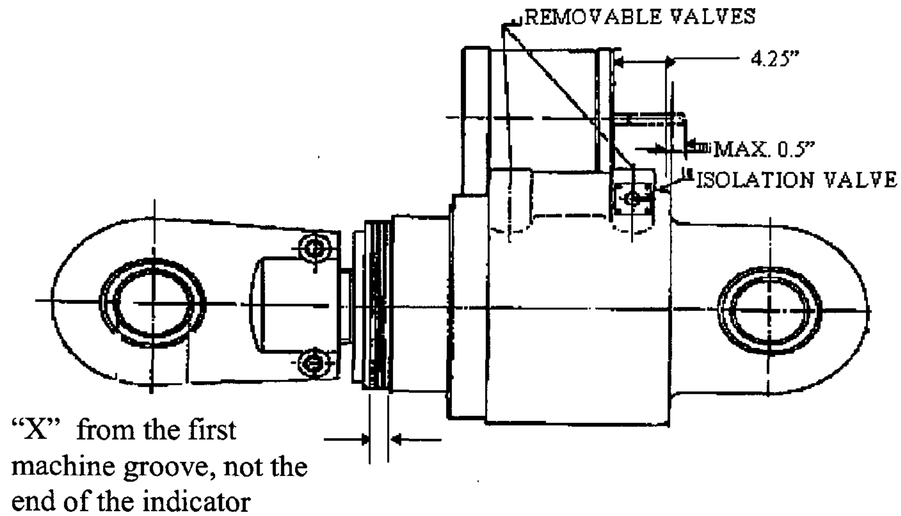


ILLUSTRATION 8
(Page 1 of 2)

LISEGA MINIMUM FLUID LEVEL PLUNGER AND PISTON
POSITION MEASUREMENT IN THE FIELD

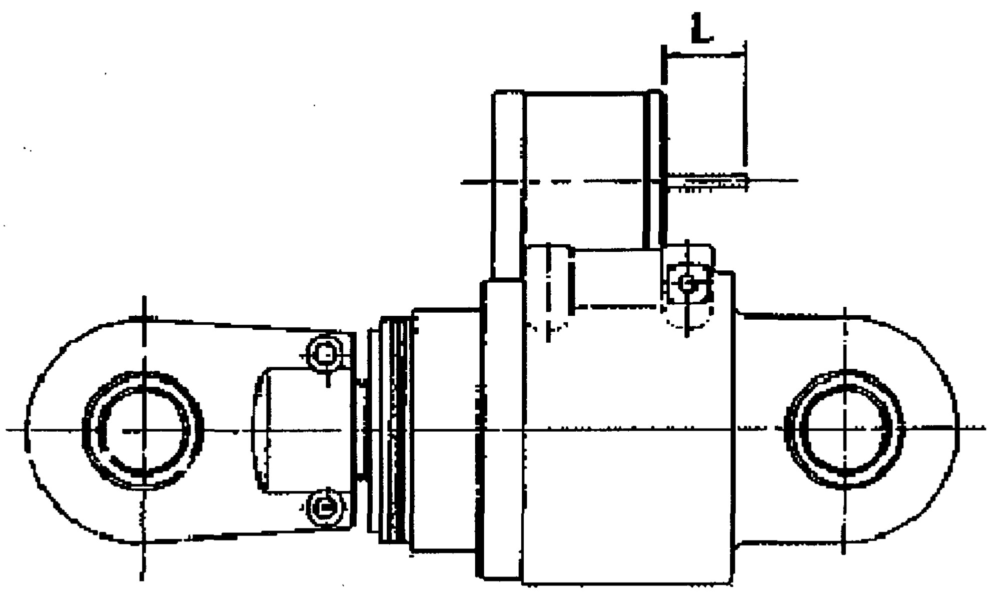


ILLUSTRATION 8
(Page 2 of 2)

LISEGA MINIMUM FLUID LEVEL PLUNGER
MEASUREMENT IN THE FIELD

If the as-found Reservoir plunger position "L" is below the minimum value given, the fluid level is unacceptable. ADD API 280 Silicon hydraulic fluid to the snubber to bring the reservoir, as close as possible, to its optimum (maximum) level. No functional testing of the Lisega Torus Dynamic Restraint Snubber is required due to this refilling operation.

Nomenclature:

X - Measurement of the piston position in inches from the front head of the snubber to the first machined groove on the indicator, not the end (See ILLUSTRATION 7).

L Minimum - The minimum fluid level in the reservoir for the piston position measured from the front of the reservoir to the end of the reservoir piston rod.

L Maximum - The maximum fluid level in the reservoir for the piston position measured from the front of the reservoir to the end of the reservoir piston rod.

If the "X" measurement shown in Illustration 7 is between the numbers given in the table below for "X", then go to the next lower reading for "X" to determine the L Minimum and L Maximum.

"X" (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.49	3.27
0.125	2.39	3.18
0.250	2.30	3.09
0.375	2.21	3.00
0.500	2.12	2.91
0.625	2.03	2.81
0.750	1.93	2.72
0.875	1.84	2.63
1.000	1.75	2.54
1.125	1.66	2.45
1.250	1.57	2.35
1.375	1.47	2.26
1.500	1.38	2.17

APPENDIX A
(Page 1 of 1)

SUBGROUPING AND SERVICE LIFE MONITORING OF SNUBBERS

1.0 SUBGROUPINGS

For functional testing, the snubbers are divided into one subgroup as described below:

1.1 Subgroup 5 Bergen-Paterson and Lisega Torus Dynamic Restraint hydraulic snubbers. For functional testing of Bergen Paterson snubbers, see 0-SI-4.6.H-2C.

1.2 When snubbers are added, deleted, or changed, based on modifications, they are added or deleted from their appropriate subgroups. If the added snubbers do not fit an existing subgroup, a revision to this SI describing the new subgroup or a revision to an existing subgroup is required. Table A-1 of this SI must be revised when the subgroups change.

1.3 There have been no failures of snubbers in these locations at this time; therefore, testing 10 percent of the snubbers in these areas each refueling outage satisfies the intent of the surveillance requirement.

TABLE A-1
SUBGROUPING OF SNUBBERS

Category Number	Subgroup Number (1)	Description	Quantity Unit 2	Quantity Unit 3
7*	5 (Lisega only)	LISEGA Hydraulic Torus Dynamic Restraint	7	4

* This category is accessible at any time during power operation for the purpose of functional testing.

1. The subgroup listed is based on the design features and according to the manufacturer.

Total Lisega Torus Dynamic Restraint Snubbers installed in Unit 2 and 3 is 11.

APPENDIX B
(Page 1 of 1)

COMMON MODES OF SNUBBER FAILURE
AND POSSIBLE CAUSES

TYPE	COMMON MODES OF FAILURE	POSSIBLE CAUSE
HYDRAULIC	No Lockup	Wrong size poppet. Wrong size poppet spring. Poppet frozen or blocked open. Excessively low or no fluid. Lockup adjustment set improperly. Damaged piston rod seal. Damaged O-ring.
	High Lockup	Wrong size poppet. Wrong size poppet spring lockup velocity. Adjustment set improperly. Damaged O-ring.
	Low Lockup	Broken poppet spring. Poppet frozen or blocked closed. Lockup velocity. Adjustment set improperly. Foreign objects in fluid.
	High Bleed	Defective or damaged poppet. Defective or damage poppet seat. Wrong size poppet. Bleed adjustment set improperly. Damaged O-ring.
	No Bleed	Foreign objects in fluid. Bleed adjustment set improperly.
	Miscellaneous	Hardware. Improper installation. Improper handling or abuse. Misapplication. Overload. Vibration or wear.

APPENDIX C
(Page 1 of 3)

DAILY STARTUP PROCEDURE FOR THE STB-200 TEST BENCH

1. DAILY STARTUP PROCEDURE

1.1 WARM-UP

Exercise both benches (i.e., small and large) by selecting the Manual Control Panel function from the Tool Menu.
Clicking on "Auto Exercise" in the Operating Mode block will cause the selected bench to automatically stroke back and forth. The system should be run this way until the oil temperature is above approximately 70°F or smooth operation is attained. Both test benches should be exercised. To change from one bench to the other, click on the bench label.

1.2 CHECK THE PRESSURE TRANSMITTER

NOTE: This instrument does not provide safety-related data. This check is optional.

In the Manual Control Panel mode, SELECT Manual in the Operating Mode block. Turn the "HP Pump" on, Then use the HP Pump slider to increase the pressure command setting until the "Pressure" reading is approximately 2000 psi. Check the 0-3000 psi gauge in the front of the HPU. The two readings should be within ~ 200 psi.

1.3 PARK THE RAM

SELECT the "Park the Ram" to prepare the bench for the Daily Calibration Check. This should be done for both benches.

1.4 SHUT DOWN THE MANUAL CONTROL PANEL

Click on "Shut Down" to exit the Manual Control Panel.

2. Status Check

2.1 During the warm-up period, the frame drive cylinders should be stroked using the proportional valve and or the jog/drag valve.

2.2 The system should be checked for loose fittings, bolts, etc.

2.3 The filter indicators should be watched during cylinder stroking to insure that they are not illuminating.

2.4 If the indicators are illuminating, the filters should be changed before continuing with operation of the machine or any testing.

APPENDIX C
(Page 2 of 2)

DAILY STARTUP PROCEDURE FOR THE STB-200 TEST BENCH

3. Daily Calibration Checks

The following calibration checks assure the functionality of the instrument and Data Acquisition and control System (DAS) for testing. They do not take the place of full system calibrations which must be performed on a periodic basis.

The instrument system (DAS system and transmitters) should be powered up to 30 minutes before any checks or testing is performed.

Prior to performing this function, both rams should have been "Parked" using the "Park the Ram" function in the Manual Control Panel.

3.1 SELECT THE DAILY CALIBRATION FUNCTION

SELECT the Daily Calibration Check function from the "Tools" menu.

3.2 CONNECT THE LOW RANGE LOAD CELL AS DIRECTED

If directed to by the software, electrically connect the Low Range Load Cell as instructed. The load cell does not need to be mechanically mounted in the test bench, but it must be connected to its electrical cable.

3.3 STORE THE "ZERO" CALIBRATION READINGS

For each instrument click the "STORE" button in the "ZERO" column on the Daily Calibration screen for that instrument. The zero reading will be captured in the "Actual" "Zero" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.4 STORE THE "SPAN" CALIBRATION READINGS

For each instrument, press in the "CAL" button on the front of the instrument, then click the "STORE" button in the "SPAN" column on the Daily Calibration screen for that instrument. The span reading will be captured in the "ACTUAL" "SPAN" column. If it is within limits, the box will turn gray. If it is not within limits, the box will turn yellow.

3.5 PRINT THE REPORT

When all readings for both benches have been stored, click on the "PRINT" button to print the Daily Calibration Report. If the report is "SATISFACTORY", continue the testing. If the report is "UNSATISFACTORY", halt and correct the problem before continuing.

ATTACHMENT 1
(Page 1 of 1)

SURVEILLANCE INSTRUCTION REVIEW FORM

DATE/TIME STARTED ____________ DATE/TIME COMPLETED __________

REASON FOR TEST:
____ Scheduled Surveillance
____ System Inoperable (Explain in Remarks)
____ Maintenance (WO# ______________)
____ Other (Explain in Remarks)

PLANT MODE 1 2 3 4 5 (Circle Appropriate Mode)
MODE 1-POWER OPERATION
MODE 2-STARTUP
MODE 3-HOT SHUTDOWN
MODE 4-COLD SHUTDOWN
MODE 5-REFUELING

FLUID TYPE_______________ TIIC/STOCK NO._______________ 575N/SIR___________________

PRE-TEST REMARKS: ____

____

PERFORMED BY:

Initials	Name (Print)	Name (Signature)
________	____________________	____________________
________	____________________	____________________
________	____________________	____________________
________	____________________	____________________

NOTE: The following entries for contacting Shift Manager/Unit Supervisor shall be marked N/A if the snubber is not Inoperable.

NOTIFY Shift Manager/Unit Supervisor when snubber found Inoperable. _________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted____________ Date________ Time ______

NOTIFY Shift Manager/Unit Supervisor when snubber Operability is restored _________ (Initial)

NAME of Shift Manager/Unit Supervisor Contacted____________ Date________ Time ______

==

SECTION REVIEWER (MM) - ________________________________ Date _____________

==

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instruction in that: the recording, reduction, and evaluation of data is complete and correct; acceptance criteria is met or justification for exceptions is provided; portions of test performed were appropriate for specified test conditions or reasons for test; deficiencies were evaluated and dispositioned; reportability was evaluated; marginal results were evaluated with respect to potential for future problems based on operating experience and regulatory requirements; and instruction was complete except as noted in post-test remarks.

SNUBBER ENGINEER/
SITE ENGINEERING CIVIL REVIEWER - ______________________ Date _________

==

SCHEDULING COORDINATOR - ______________________________ Date _____________

==

POST-TEST REMARKS: ____ FREQ -

____ FREQ IN RO -

____ KEY - 3395B

ATTACHMENT 2
(Page 1 of 5)

NOMENCLATURE

	TYPE 312150	TEST/SURROGATE SNUBBER
FORCE OF SNUBBER	F_S	*F_T
LOCK-UP VELOCITY (ACTIVATION VELOCITY)	**V_{LS}	*V_{LT}
BY-PASS VELOCITY (RELEASE/BLEED RATE)	**V_{BS}	*V_{BT}

NOTE:
1. F_S value of 247 kips may be used as excerpted from Vendor Document Number: BFN-VTD-L329-0070.

CONVERSION

Lock-up

Lock-up velocity, in Tension: V_{LS} Tension = 0.59 X V_{LT} Tension

V_{LS} Tension = 0.59 X ________ = ________

Lock-up velocity, in Compression: V_{LS} Comp = 0.69 X V_{LT} Comp

V_{LS} Comp = 0.69 X ________ = ________

By-pass velocity

By-pass velocity, in Tension: V_{BS} Tension = 0.37 X V_{BT} Tension X $\sqrt{\frac{F_S}{F_T}}$

V_{BS} Tension = 0.37 X ________ X ______ = ________

By-pass velocity, in Compression: V_{BS} Comp = 0.39 X V_{BT} Comp X $\sqrt{\frac{F_S}{F_T}}$

V_{BS} Comp = 0.39 X ________ X ______ = ________

________________________________/________
Snubber Engineer/SE Designee Date

Legend:
* - Data from the "Printed Test Result" of a functional test performed on Lisega Test/Surrogate snubber.
**- CONVERTED value resulting from the above conversion for the Lisega (Type 312150) restraint.

ATTACHMENT 2
(Page 2 of 5)
AS-FOUND TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number:________________ Date:__________
System Number: ________________ Exam Number:________________
Snubber UNID Number:________________ Snubber Rated Load:__________
Serial Number: ________________ Load Cell Number: __________
Calibration Due Date:

	Activation (in/min)	Acceptance Criteria*	Performer Signature/ Date
Tension Compression	________ ________	6 in/min ≤ Activation ≤ 25 in/min	________________ Signature __________(AC) Date
	Bleed (in/min)		
Tension Compression	________ ________	Bleed takes place after snubber activation	________________ Signature __________(AC) Date
	Load lbs)		
Tension		None	________________ Signature __________ Date
Compression			
	Drag ** (lbs)		** See Note below
Tension Max: Avg: Compression Max: Avg:	 NA NA NA NA	MAXIMUM 15,000 Pounds	________________ Signature __________(AC) Date
Copy of the plotted As-Found test results is attached to this data sheet.			________/______ Initials /Date

* Case Specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Found acceptance criteria____ Yes ___ No
If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

________________________/______
Snubber Engineer/SE Designee Date

Note:
**- NA denotes that freedom of movement is not restricted, and verified.

ATTACHMENT 2
(Page 3 of 5)
AS-LEFT TORUS DYNAMIC RESTRAINT TEST DATA

Work Order Number: ____________________ Date: __________
System Number: ________________________ Exam Number: ______________
Snubber UNID Number: __________________ Snubber Rated Load: __________
Serial Number: ________________________ Load Cell Number: ____________
Calibration Due Date:

	Activation (in/min)	Acceptance Criteria*	Performer Signature/ Date
Tension Compression	______ ______	6 in/min ≤ Activation ≤ 25 in/min	____________ Signature ________ (AC) Date
	Bleed (in/min)		
Tension Compression	______ ______	Bleed follows Activation, shall be in the range of .28 in/min - 1.18 in/min	____________ Signature ________ (AC) Date
	Load lbs)		
Tension Compression		None	____________ Signature ________ Date
	Drag ** (lbs)		** See Note below
Tension Max: Avg: Compression Max: Avg:	NA NA NA NA	MAXIMUM 15,000 Pounds	____________ Signature ________ (AC) Date
Copy of the plotted As-Left test results is attached to this data sheet.			______/______ Initials /Date

* Case Specific Acceptance Criteria may be approved on Attachment 5.

Snubber meets As-Left acceptance criteria____ Yes ___ No
If the answer to the above is "No", Notify the Snubber Engineer/SE Designee immediately.

______________________________/________
Snubber Engineer/SE Designee Date

Note:
**- NA denotes that freedom of movement is not restricted, and verified.

ATTACHMENT 2
(Page 4 OF 5)
REMOVAL AND REINSTALLATION OF LISEGA TORUS DYNAMIC RESTRAINTS

WO No. ________________ Unit __ Snubber UNID No. _______________

Serial No. __________ Subgroup _____ Test Lot: Initial ____ Subsequent _____

Exam No. _______ Size _______ Rated Load ___________ Lbs. Pipe Size _____

Design drawing number _________________

Shift Manager/Unit Supervisor and Snubber Engineer/SE Designee notified prior to removal of restraint for functional testing.

___________________________ __________ _________
Foreman/Designee Date Time

As-Found Stroke/Piston Setting ________
Required Stroke/Piston Setting ________
(from Design drawing)

The As-Found Stroke Setting is within the acceptable limits shown in the Design drawing listed above.

______ Yes _______ No _____________________/______(AC)
Performer Signature Date

All fasteners for the As-Found snubber are secured and acceptable (i.e., no loose or missing fasteners on the component or anchorage).
If the answer is "No", complete Attachment 6.

______ Yes _______ No _____________________/_______(AC)
Performer Signature Date

Review test data for acceptability. If the test results are unacceptable, specify the action to be taken: ____

____
____
____

____________________________/______
Snubber Engineer/SE Designee Date

ATTACHMENT 2
(Page 5 OF 5)
REMOVAL AND REINSTALLATION OF LISEGA TORUS DYNAMIC RESTRAINTS

W O No. ____________________ Unit __ Snubber UNID No. __________________

Snubber reinstallation:

Same snubber reinstalled	___Yes ___No
If No, enter Lisega TDR serial number	__________ Serial Number (Lisega TDR)
Snubber is reinstalled in proper location	___Yes ___No
Snubber is reinstalled with base of housing up	___Yes ___No
All locking devices are secured	___Yes ___No
Cotter pins are spread	___Yes ___No ___N/A
Spherical bearing greased	___Yes ___No ___N/A
Gaps between spacers and spherical bearing are 1/16 inch each side, 1/8 inch total or less	___Yes ___No
Snubber is tagged	___Yes ___No
Bolts and jam nuts torqued	___Yes ___No ___N/A
Anti-seize compound applied, as needed	___Yes ___No ___N/A

As-Left Stroke Setting ________
Torque Wrench No. _____________
Calibration Due Date __________

______________________/________
Performer Signature Date

The As-Left Stroke Setting is within the acceptable limits shown in the design drawing as verified.
_______ Yes _______ No

______________________/________
Performer Signature Date

SHIFT MANAGER/UNIT SUPERVISOR notified of operable and reinstalled snubber.

______________________/________
Foreman/Designee Date

Remarks:____
____
____

ATTACHMENT 3
(Page 1 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ______________ Unit _ Snubber UNID No. _________________

Subgroup No. _____ PER No. _________________ Mfg./Size ___________________________

Serial No. _________ Rated Load __________ Exam No. _____ Lot _____

1. Describe the mode of failure(s), as discussed on Appendix B.

☐ Locked up ☐ High Drag Force
☐ Snubber would not activate ☐ Damage to snubber hardware

Explain (if necessary)

2. Describe the conditions of the failure:

3. Determine the cause of failure, using Appendix B for the possible causes (disassembly of the snubber may be necessary):

4. For a snubber that does not activate, release, or locked up, was the cause of the failure a design or manufacturing defect? ☐ Yes ☐ No
If yes, contact the Snubber Engineer/SE Designee for further actions to be taken.
Explain Evaluation:

ATTACHMENT 3
(Page 2 of 2)

ENGINEERING FAILURE ANALYSIS FOR
SNUBBER DECLARED INOPERABLE

WO No. ____________ Unit _ Snubber UNID No. ______________

Subgroup No. _____ PER No. ______________ Mfg./Size ______________________

Serial No. _______ Rated Load _________ Exam No. _____ Lot _____

5. Snubber Failure is classified as: ☐ Isolated ☐ Location
☐ Manufacturing ☐ Design ☐ Unknown ☐ Other

Describe the basis for the classification:

6. For Subgrouping Purposes Only - Evaluation of subgroup composition (new type snubber, changing subgroup of existing snubber, etc.)

7. Does the vendor need to be contacted? ☐ Yes ☐ No
Vendor Name:
Person contacted: Date:
Vendor's Comments:

8. What subsequent testing is required because of this failure?

Subsequent Lot No. No. of snubbers to be tested

9. What corrective action and recurrence controls are to be taken?

Evaluation performed by: ______________________________/________
Snubber Engineer/SE Designee Date

ATTACHMENT 4
(Page 1 of 1)
SUPPORTED COMPONENT OR SYSTEM ANALYSIS FOR
INOPERABLE SNUBBER

WO No. ____________ Unit _ Snubber UNID No. _______________

Subgroup No. _____ PER No. _______________ Mfg./Size ______________________

Serial No. ________ Rated Load _________ Exam No. _____

1. Describe the condition(s) (Whether the snubber would not activate, was the snubber locked up, or excessive drag force, etc.)

2. Attach the SE Evaluation of the attached component:

3. Describe the corrective action to be taken (repair, replacement, additional testing, future testing, service life monitoring, etc., for evaluation of subgroup composition, etc. Use additional sheets as necessary):

____________________________/_______
Snubber Engineer/SE Designee Date

ATTACHMENT 5
(Page 1 of 1)
CASE SPECIFIC ACCEPTANCE CRITERIA

WO No. ____________ Unit _ Snubber UNID No. ______________

Subgroup No. _____ PER No. ______________ Mfg./Size ______________________

Serial No. _______ Rated Load _________ Exam No. _____

1. Describe the standard acceptance criteria:

☐ As-Found ☐ As-Left

2. Record the parameter(i.e., activation, bleed, drag) and the test results that are outside the standard acceptance criteria:

☐ As-Found ☐ As-Left

3. Test results for parameters listed in item 2 are acceptable for case specific acceptance criteria:

☐ Yes ☐ No

4. If evaluation is for As-Found acceptance criteria, is functional testing of an additional lot in accordance with Steps 7.5.9 through 7.5.19 required:

☐ Yes ☐ No

Justification for determination (items 3 and 4):

______________________/________
Site Engineering Civil Date

ATTACHMENT 6
(Page 1 of 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners, used for attachment of snubber(s) to component, and to anchorage, are discovered loose or missing prior to the As-Found functional testing.

W O No. ________________ Unit __ Date Discovered _________

Snubber UNID _________________ Serial No. ________ Subgroup No. _____

Exam No. _______ Size _______ Rated Load ________ Lbs. Pipe Size ____

1. Describe the discovered condition(s):

____

____

2. If possible, determine cause: ____

____

____

____

____

Evaluated by: ____________/______
Date

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.

____

____

____

____

Evaluated by: ____________/______
Date

4. Describe the corrective action(s) and provide the As-Found test result.

____

____

____

____

____

____

____

Entered by: ____________/______
Date

Attachment G

BFN Technical INSTRUCTION

0-TI-398,

Snubber Program Procedure

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

TECHNICAL INSTRUCTION

0-TI-398

SNUBBER PROGRAM PROCEDURE

Revision 3

QUALITY RELATED

PREPARED BY: B. M. PEDROSO JR.

RESPONSIBLE ORGANIZATION: SITE ENGINEERING - CIVIL DESIGN

APPROVED BY: JERRY BEASON DATE: 12/12/2003

EFFECTIVE DATE: 12/12/2003

LEVEL OF USE: REFERENCE USE

PAGES AFFECTED: ALL

DESCRIPTION: IC-04

This procedure is being revised to document NRC approval of the Snubber Relief Request 2-ISI-13 (TAC No. MB6596) for BFN Unit 2, update the visual acuity requirements of personnel performing visual inspection per 2-SI-4.6.H-1 and 3-SI-4.6.H-1, and correct hardware and software parts list in Appendix B.

TABLE OF CONTENTS

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Page 2 of 3

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Page 3 of 3

1.0 INTRODUCTION

1.1 Purpose

The purpose of this Technical Instruction (TI) is to provide a single source of guidance, explanations, and information, with regard to snubbers, that is required to establish and maintain the Browns Ferry Snubber Program. The more knowledgeable reader will be able to utilize this document to examine, evaluate, and/or administer the Browns Ferry Snubber Program.

1.2 Scope

A. This SSP applies to all mechanical and hydraulic snubbers, safety-related or non-safety-related.

B. This SSP applies to TVA employees, contractor, and vendor employees involved with snubber inspection, testing, maintenance, procurement, storage, design, installation, or modification.

C. Snubber program regulatory requirements apply only to safety-related snubbers.

D. Snubber program satisfies alternative to sub-article, IWF-5300 and IWA-6230 of Section XI of the ASME Code requirements for Unit 3 per NRC approval of "Snubber Request for Relief 3-ISI-2", dated May 3, 1999.

E. Snubber program satisfies alternative to sub-article, IWF-5300 and IWA-6230 of Section XI of the ASME Code requirements for Unit 2 per NRC approval of "Snubber Request for Relief 2-ISI-13", dated January 7, 2003.

2.0 REFERENCES

2.1 Source References

A. API/Barker STB-200 Snubber Test Bench Manual

B. API/Barker STB-200 Snubber Test Bench Software Quality Assurance Plan

C. BFN-VTM-B209-0160, Vendor Technical Manual For Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressors.

D. BFN-VTD-B209-0180, Installation Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressors.

2.1 Source References (Continued)

E. BFN-VTD-B209-0200, Removal Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressors.

F. BFN-VTM-P029-0010, Vendor Technical Manual for Pacific Scientific Instruction Manual for Repair, Overhaul, Installation Maintenance of Mechanical Shock Arrestors.

G. BFN-VTD-P029-0050, Pacific Scientific Instruction Manual Installation and Maintenance Mechanical Shock Arrestors Models PSA-1/4, PSA-1/2, PSA-1, PSA-3, PSA-10, PSA-35, PSA-100

H. BFN-VMM-P029-0250, Vendor Miscellaneous Manual For Pacific Scientific Mechanical Shock Arrestors.

I. BFN-VTM-G257-0010, Vendor Technical Manual For Grinnell Corp. Hydraulic Snubbers

J. BFN-VTM-L329-0010, Vendor Technical Manual For Lisega Reactor Torus Ring Hydraulic Snubbers

K. BFN-VTD-L329-0070, Installation and Maintenance Instructions For Lisega Hydraulic Snubbers

L. Relief Request 3-SI-2 (TAC NO. M97805), dated May 3, 1999 NRC Letter, "Browns Ferry Nuclear Plant, Unit 3 - Relief From ASME Boiler and Pressure Vessel Code, Section XI Requirements

M. Technical Requirements Manual (TRM) Technical Requirement TR 3.7.4, "Snubbers"

L. Relief Request 2-ISI-13 (TAC NO. MB6596), dated January 7, 2003 NRC Letter, "Browns Ferry Nuclear Plant, Unit 2 - Relief From ASME Boiler and Pressure Vessel Code, Section XI Requirements

2.2 Developmental References

A. General Engineering Specification G-43, "Installation, Modification, and Maintenance of Pipe Supports and Pipe Rupture Mitigative Devices"

B. 0-TI-363, ASME Section XI Repair and Replacements

C. 1-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

2.2 Developmental References (Continued)

D. 2-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

E. 3-SI-4.6.H-1, Visual Examination of Hydraulic and Mechanical Snubbers

F. 0-SI-4.6.H-2A, Functional Testing of Mechanical Snubbers

G. Canceled and Superseded by SI 0-SI-4.6.H-2A.

H. Canceled and Superseded by SI 0-SI-4.6.H-2A.

I. 0-SI-4.6.H-2B, Functional Testing of Bergen-Paterson, Anchor Darling, Fronek Hydraulic Snubbers

J. Canceled and Superseded by SI 0-SI-4.6.H-2B.

K. Canceled and Superseded by SI 0-SI-4.6.H-2B.

L. 0-SI-4.6.H-2C, Functional Testing of Bergen-Paterson Torus Dynamic Restraints

M. Canceled and Superseded by SI 0-SI-4.6.H-2C.

N. Canceled and Superseded by SI 0-SI-4.6.H-2C.

O. 0-SI-4.6.H-2D, Functional Testing of Grinnell Hydraulic Snubbers

P. Canceled and Superseded by SI 0-SI-4.6.H-2D.

Q. 0-SI-4.6.H-2E, Functional Testing of Large Bore Lisega Torus Dynamic Restraint Snubbers

R. Canceled and Superseded by SI 0-SI-4.6.H-2E.

S. MPI-0-000-SNB001, Hydraulic Shock and Sway Arrestor Grinnell Unit Disassembly and Reassembly

T. MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor Darling, Fronek Unit Disassembly and Reassembly

U. MPI-0-000-SNB004, Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Snubbers

2.2 Developmental References (Continued)

V. NUREG/CR-5870, Results of LWR Snubber Aging Research, Published May 1992

W. SPP-3.1, Corrective Action Program

X. SPP-8.1, Conduct of Testing

Y. SPP-9.1, ASME Section XI

Z. Snubber Technical and ISI Review Course, by Lake Engineering Company, Warwick, Rhode Island

3.0 DEFINITIONS

A. **Activation (Lockup)** - The change of condition from passive to active, in which the snubber restrains the rapid displacement of the supported system/component.

B. **API/BARKER Test Bench** - An automated mechanical test device designed to perform functional testing of snubbers. The current name of the test bench vendor is Barker/Diacon.

C. **As-Found Test** - As-found test means the snubber must be tested without performing any kind of maintenance on the snubber. Also any cleaning of the snubber exterior surface is precluded. Stroking of the snubber prior to testing should be avoided, however, test sequence (i.e. activation is to be done first or drag force test is to be done first) is insignificant.

D. **Bench Testing** - Functional testing of snubbers utilizing the STB-200 or similar equipment.

E. **Bleed Rate (Release)** - The rate of snubber axial movement under a specified load after activation of the snubber takes place.

F. **Breakaway Force** - The minimum applied force to initiate extension or retraction of the snubber.

G. **Drag Force** - The force required to maintain snubber movement at a low velocity or acceleration before activation.

H. **Fasteners** - Securing devices such as lock wire, locking tabs, jam nuts, attachment welds, cotter pins, etc. which can be detected by visual observation.

I. **Freedom-of-Motion, or Push-Pull Method** - Manual stroke of snubber through its full range of motion. This is commonly used to check suspected transient snubbers for damage.

J. **Functional Testing** - Measurement or checks of parameters that verify operational readiness.

3.0 Definitions (Continued)

K. **Hydraulic Snubber** - Snubbers in which load is transmitted through a hydraulic fluid. Hydraulic snubbers are equipped with control valves which defeat the restraining action of the snubber, allowing it to move relatively freely until a specific velocity called activation or lock-up velocity is reached. At this velocity the control valve closes and the snubber starts to restrain the velocity of the attached component.

L. **Maintenance** - Action taken to prevent and correct deficiencies in the function of a snubber.

M. **Mechanical Snubber** - Snubber in which load is transmitted entirely through mechanical components. Mechanical snubbers are designed to restrain pipe or equipment to a specific limited acceleration or rate of velocity change during an event. For normal thermal motion the snubber will move freely in either direction through its operating stroke.

N. **Operable** - The ability of a snubber to perform its intended design function.

O. **Snubber** - Dynamic restraints which are utilized to allow slow, constant movement of a supported system/component while providing rigid restraint against rapid motion due to dynamic loads (i.e., earthquakes, transients, etc.).

P. **Spacers** - Devices located on each side of the spherical bearing used to position the snubber clevis attachment in the center of the end attachment. These are also known as washers.

Q. **Spherical Bearing** - Load bearing which allows the snubber to rotate in the end attachments.

R. **Stroke** - Full length of the total possible snubber movement.

S. **Technical Requirements Manual Snubber** - Snubbers that are required for safe shutdown, required to protect code boundaries and to ensure system/component structural integrity under dynamic loads. These are known as Essential, Safety-related or Quality-related.

3.0 Definitions (Continued)

T. **Thermal Movement** - The amount the system/component is analytically predicted to move from its Cold position to its Hot (Operating) position during normal or emergency system operation. Thermal movement can be either in tension or compression and this movement is identified on the support design drawings.

U. **Unstaked, Internal** - Rotation occurs between the support cylinder and the position tube indicator, for Mechanical snubbers.

V. **Unstaked, spherical Bearing** - Spherical bearing, used for snubber alignment, is found displaced from the paddle plate.

W. **Visual Examination** - The performance of visual observations for detection of improper installation and impaired functional ability caused by physical damage, leakage, corrosion, or degradation from environmental or operating conditions.

X. **Work Implementing Document (WID) -** Workplan, Maintenance Instruction, Work Order, or other similar document which consists of written directions for performance of work.

4.0 GENERAL PRECAUTIONS

NONE

5.0 PREREQUISITES

NONE

6.0 EQUIPMENT

NONE

7.0 PROCEDURE

7.1 General

Snubbers are dynamic restraints that are utilized to allow slow, constant movement of a supported system/component while providing rigid restraint against rapid movement due to dynamic loads. Snubbers are installed on piping and/or equipment primarily to limit the displacement of the piping or equipment during a seismic event or during a severe transient. They are sometimes installed to limit damage from pipe break, vibration, and water hammer. Snubbers accomplish this by absorbing the energy from the supported system/component motion and transmitting it to the building structure.

Snubbers can directly affect plant safety, therefore, periodic inspection, testing, and appropriate maintenance is required to ensure their operability. Inoperable snubbers may severely damage piping or equipment either by not restraining them during a seismic event or transient, or by not allowing thermal expansion during normal plant operation.

Technical Requirements Manual (TRM) Technical Requirement (TR) 3.7.4, “Snubbers", requires all safety-related snubbers to be operable during all modes of operation. However, if a component or system affected by the snubber(s) is not required to be OPERABLE, then the snubber is not required to be OPERABLE, except as follows: The snubber(s) located inside the drywell, on the reactor vessel attached piping systems shall be considered OPERABLE whenever fuel is in the reactor vessel. The snubber(s) on Main Steam, HPCI and RCIC piping, in the drywell, are exempt from this requirement when the steam line plugs are installed inside the reactor vessel. During the times snubber(s) are not required to be OPERABLE for an inoperable system, the inoperable snubber(s) will be tracked to prevent declaring the system OPERABLE with unanalyzed inoperable snubber(s).

At the present time there are four manufacturers and five types of snubbers at Browns Ferry. These are Bergen-Paterson (also known as Anchor/Darling or Fronek) and Grinnell Hydraulic (piping and equipment), Bergen-Paterson and Lisega (Torus Dynamic Restraints) and Pacific Scientific Company Mechanical Snubbers. The types and pertinent information about each will be given in Appendix B, C, D, E and F of this procedure.

7.2 Program Ownership

The snubber program is maintained by the Site Engineering, Civil Engineering Group. The primary owner of the program is the Site Snubber Program Engineer (SSPE). The SSPE must have a broad knowledge of plant systems and shall be cognizant of snubber inspections and testing requirements.

7.3 Duties and Responsibilities

A. The SSPE responsibilities are as follows:

1. Ensures overall snubber operability and compliance with TR 3.7.4 requirements and other snubber related regulatory requirements.
2. Maintains the technical adequacy and accuracy of snubber program procedures.
3. Performs revisions and develops new procedures for snubbers, as required.
4. Implementation of program procedures.
5. Initiates all Work Orders for snubber work to be performed prior to and during the outage (i.e., removal and reinstallation, rebuild and functional testing).
6. Provides information to Planning for completion of ASME Section XI Repair and Replacement paperwork, Section XI NIS-2 form and Work Order.
7. Ensures that proper maintenance is scheduled and performed on snubbers.
8. Ensures adequate inventories of required snubbers and spare parts.
9. Issues purchase request for snubber spare parts and personnel services, as required.
10. Updates the snubber tracking program with required information, as required.
11. Reviews and evaluates all snubber test data to ensure it meets all acceptance criteria.
12. Performs failure analyses and other evaluations of failed and degraded snubbers.
13. For Unit 3, has primary responsibility for the implementation of the ASME Section XI inspection program for snubbers.

7.4 Interfaces

A. Operations -

1. Ensures compliance with Technical Specification and Requirements Manuals by determining when removal of snubbers for testing or maintenance is allowed based on plant conditions.
2. Tracks all Limiting Conditions Of Operation (LCOs) for snubbers.
3. Approves and tracks Work Orders for snubbers being worked.

B. Mechanical Maintenance -

1. Supports surveillance activities by performing the removal, rebuild, installation and transport of all hydraulic snubbers.
2. Performing the removal, installation and transport of some mechanical snubbers.
3. Performs maintenance and repairs on failed or degraded snubbers.
4. Performs functional (Push-Pull force gauge) testing of Mechanical Snubbers.
5. Performs all visual examinations, as required.
6. Provides necessary information to the SSPE to ensure proper updating of snubber program procedures

C. Site Engineering - Design

1. Provides clear and concise design requirements for both TVA and vendor installed equipment to ensure that all regulatory and Browns Ferry site specific requirements are met relative to snubbers.
2. Defines and evaluates test acceptance criteria which is not met.
3. Performs Supported System/Component Analyses for inoperable snubbers.
4. Reviews and updates the snubber unique identifier list (Master Equipment List) in EMPAC.

D. Modifications -

1. Deletes, installs, and/or modifies snubber supports in accordance with design output documents.
2. Provides necessary information to the SSPE to ensure proper updating of snubber program procedures.

7.4 Interfaces (Continued)

E. Materials and Procurement -

1. Procures and stores snubbers, snubber parts, support parts and hardware, in accordance with procurement documents.
2. Maintains an adequate inventory of new spare parts, as specified by the SSPE, to ensure availability of parts for maintenance.

F. Component Engineering -

1. For Unit 2, has primary responsibility for the implementation of the ASME Section XI inspection program for snubbers.
2. Has responsibility for the implementation of the ASME Section XI Repair and Replacement Program.

G. Planning and Scheduling -

1. Coordinates with the SSPE for snubber surveillance activities to be performed for operating cycle. Snubbers installed on systems that are inside the drywell are to be scheduled for testing or maintenance during those system outages, if possible, so that system operability will not be affected. Scheduling of the Torus Restraint Snubbers for testing and maintenance must be performed during the refuel outage and coordinated with the SSPE to ensure the proper contracts are in place.
2. Prepares and obtains approvals on ASME Section XI Repair and Replacement paperwork, Section XI NIS-2 forms and Work Orders.

7.5 Regulatory Requirements

A. Technical Requirement (TR) 3.7.4 contains the snubber surveillance requirements and Limiting Conditions for Operation (LCO). Every requirement in the TR should be reviewed carefully and should be specifically incorporated in the plant surveillance instructions.

B. Adverse condition reporting requirements shall be in accordance with SPP-3.1, "Corrective Action Program".

C. Those safety-related snubbers on the portions of systems covered by Section XI are subject to the requirements of SPP-9.1, ASME Section XI.

7.5 Regulatory Requirements (Continued)

D. The ASME Section XI Repair and Replacement process shall be performed in accordance with 0-TI-363, ASME Section XI Repairs and Replacements.

E. The ASME Section XI requirements have been augmented by the approval of Request for Relief 3-SI-2, shown in Appendix A of this procedure.

F. The ASME Section XI requirements have been augmented by the approval of Request for Relief 2-ISI-13, shown in Appendix J of this procedure.

7.6 Snubber UNIDs, Lists, and Drawings

A. Unique Identifiers (UNIDs)

Each snubber is represented on a pipe support drawing. The Unique Identifier Number (UNID) is a unique number with the Plant - Unit - Function Code - Unique No. The function code should be SNUB and the Unique No. should begin with 5001 for each system. The Torus Restraint Snubber Unique No. begins with 0001. The UNIDs should be accurately recorded on the WOs to properly identify and retrieve information for work performed on the snubbers. Site Engineering, Civil Design is responsible for maintaining the UNID list.

B. Snubber Lists

1. An accurate list of all safety-related/quality related snubbers is required to ensure implementation of Technical Requirement 3.7.4. The Unit 1 safety-related snubber list is provided in Surveillance Instruction 1-SI-4.6.H-1, the Unit 2 safety-related snubber list is provided in 2-SI-4.6.H-1, and the Unit 3 safety-related snubber list is provided in 3-SI-4.6.H-1. The list contains snubber number, system No., serial number, type, size, and location, as a minimum. The listing will include the drawing number and the Inservice Inspection (ISI) isometric drawing number. Non-safety related snubbers will be listed in Preventive Maintenance Documents, as soon as practical.

B. Snubber Lists (Continued)

2. The SSPE shall update the snubber listing when the design change process adds, deletes, or changes the type of existing snubber. Update of the snubber listing shall be made after implementation of the modification. If maintenance work is performed which changes any information in the procedures, the updates should be completed as soon as practical after the change has been completed.

7.7 Outage Planning and Preparation

Outage planning and preparation should begin, as a minimum, approximately six months prior to the scheduled refueling outage (RFO). This is needed to obtain any required contract services and to review spare snubbers and spare parts inventories.

A. Previous SI Performance

The previous SI data sheets performance information from the snubber database should be reviewed to determine any specific issues that should be addressed for the next scheduled Visual Surveillance or testing interval, i.e., pre-outage and outage. Some examples are:

1. Previous functional failures due to location
2. Snubbers requiring service life monitoring
3. Recurring visual deficiencies and test failures
4. Whether the visual exams are required during this operating cycle

B. Hydraulic Snubber Seal Service Life

1. Review the snubber database and determine, using the appropriate 4.6.H-1 surveillance instruction, which hydraulic snubbers seal service life will expire prior to the next scheduled RFO. These should be scheduled for rebuild or identified for a seal life extension study.

2. Ensure an adequate supply of parts, necessary to rebuild snubbers, including seals and load-bearing/pressure-retaining parts (i.e., cylinder, piston, piston rod, tie rods, control valves, etc.) are available. Also review spare snubber availability.

3. Initiate work orders to rebuild the required selected snubbers.

7.7 Outage Planning and Preparation (Continued)

C. Functional Test Sample

1. Select a functional test sample of 10 % of each subgroup in accordance with the plant SI, preferably with the aid of the snubber database.

    a. Consider the snubbers to be rebuilt to select the initial and possible second sample.
    b. Identify candidates for possible additional samples for each subgroup.

2. Review the snubber database, visual inspection procedures and past performances to determine scaffolding and other restraints.

D. Functional Testing of Large Bore Hydraulic Snubbers

1. Since TVA does not own the necessary test equipment, initiate purchase request for onsite testing of the Bergen-Paterson Torus Dynamic Restraint snubbers. The vendor should have the capability of in-place testing.

2. Establish schedule for bringing vendors on and off site to minimize impact to other support activities. Consider scheduling contractor training at the least cost location and before the outage begins, if required.

3. The Lisega Type 31 21 50 Torus Restraint Snubbers may be tested on TVA's API/Barker STB-200 test bench using the Surrogate snubber furnished by Lisega. To satisfy the Technical Requirements Manual only the poppet valves from the Lisega Type 31 21 50 restraint are installed in the Surrogate snubber and tested. The Surrogate snubber test results are then converted to the Lisega Type 31 21 50 restraint values using conversion factors in 0-SI-4.6.H-2E, Attachment 2, Page 1 of 5.

7.8 Receipt Inspection and Storage of Snubbers

A Receipt Inspection

NOTE: The SSPE should be notified if the receipt inspection reveals any damage or dimensional discrepancy.

Snubber receipt inspection must be performed in accordance with the contract document and site Nuclear Stores procedure, SPP-4.2, Material Receipt and Inspection. Proper receipt inspection and storage of mechanical and hydraulic snubbers have a significant impact on the performance of the snubber after installation. Personnel involved in receipt inspection of snubbers are required to ensure proper care for handling and storage techniques in accordance with site procedures.

B. Storage of Snubbers After Initial Receipt Inspection and Prior To Installation (Nuclear Stores)

1. The snubber storage should be in buildings designated for storage.

2. Storage and Handling shall be performed as required in site Nuclear Stores procedure SPP-4.3, Material Storage and Handling. In part, this prescribes, "Items shall be protected from exposure to salt, spray, rain, dust, dirt, and other airborne and windblown contaminants."

3. When practicable, snubbers should be stored in their shipping container, if the container provides protection to the snubber. Packages should be labeled for easy identification of the snubber.

4. The snubbers, after removal from nuclear stores, should be protected from rain and the possibility of moisture or other liquids entering the snubber. They should also be protected from sand blasting or other activities that might result in foreign particles entering the snubber.

5. Hydraulic snubber repair kits containing elastomeric parts should be treated as finite shelf-life components in accordance with applicable shelf-life programs.

7.8 Receipt Inspection and Storage of Snubbers (Continued)

C. Storage of Snubbers After Removal From Nuclear Stores or the Plant

1. The snubber test/rebuild facility has been designated as a "B" Level Storage area.

2. The requirements for a "B" Level Storage area are as follows:

   a. Should be a fire resistant, tear resistant, weather tight, and well ventilated building or equivalent enclosure.
   b. The area shall be situated and constructed so that it will not be subject to flooding.
   c. Items shall be stored to permit air circulation.
   d. The area shall be provided with temperature and humidity control or equivalent to prevent condensation and corrosion.
   e. The minimum temperature shall be 40 degrees F and the maximum shall be 140 degrees F.
   f. The storage area shall be clearly identified as to its storage level.
   g. Verification of the storage conditions shall be provided by calibrated recorders and shall be documented.
   h. Limit and control access to the storage area.
   i. Lock storage area when not attended by an authorized person.
   j. Inspect and document on a semi-annual basis that storage area and stored items are maintained.
   k. The inspection shall be performed by an ANSI N45.2.6, Level II inspector, and documenting it on the inspection report form, Appendix E of SPP-4.3.

A sign designating the facility, as a "B" Level Storage Area, has been placed on the door.

Access is controlled by a key lock. Only a limited number of keys are available for access to the facility.

Only "Authorized Personnel" will be allowed entry into the facility without an escort. A list of "Authorized Personnel" will be issued and updated by the SSPE and the Mechanical Maintenance Manager. A copy of the list will be placed in the Duty Mechanical Maintenance Manager's log, placed on the door of the facility and other logs, as decided by management.

7.9 ALARA Planning

The SSPE must coordinate with RADCON to develop an ALARA preplanning package for the total scope of the snubber surveillance to be performed for the operating cycle. ALARA briefings should be held between RADCON and the test performers to explain high-rad areas, contamination, dress-out, stay times, and minimizing radwaste requirements.

7.10 In-Service Inspection (ISI) (ASME Section XI Requirements)

To fulfill Code of Record certification, in accordance with repair/replacement requirements of Section XI, ensure that information is readily available (i.e., original purchase specification, for new snubbers received from Nuclear Stores, and previous location, UNID and removal work document (if possible) of used snubbers being stored as spares in the snubber test/rebuild facility, for each snubber mark number within the Section XI boundary) to facilitate timely completion of work order documentation.

The ASME Section XI Inservice Inspection of snubbers, for Unit 2, shall meet the requirements of this program as documented on the snubber request for relief in Appendix J. This request for relief is approved as referenced in Section 2.1. N.

The ASME Section XI Inservice Inspection of snubbers, for Unit 3, shall meet the requirements of this program as documented on the snubber request for relief in Appendix A. This request for relief is approved as referenced in Section 2.1. L.

7.11 Spare Snubbers

A. Special emphasis should be placed on having in stock approximately 10 percent of the unit population of PSA 1/4 and PSA 1/2 mechanical snubber spares.

B. Based on improved reliability of the larger models of PSA mechanical snubbers, a stock of from 3 to 5 percent, of those sizes as spares, should be sufficient.

C. Hydraulic snubbers should be available as spares for snubbers which must be functionally tested under a Technical Requirement Limiting Condition for Operation (LCO).

D. Hydraulic snubber metallic and non-metallic parts must be verified for availability for those hydraulic snubbers scheduled to be refurbished for the RFO.

7.11 Spare Snubbers (Continued)

E. Spare snubbers for the Torus Dynamic Restraints are manufactured by Lisega and are approved as replacements for the Bergen-Paterson snubbers when removed. This replacement was approved under Design Change Notice V39267A.

7.12 Functional Test Equipment

A. Ensure the API/Barker snubber test benches calibration due dates will remain valid for the duration of the RFO.

B. Ensure an adequate supply of calibrated Push-Pull force gauges are available for drag force testing of PSA mechanical snubbers, in the field.

C. Force gauges should be sized such that drag forces can be accurately read from zero to approximately 5 percent of the rated load of the snubber to be tested.

D. Two Push-Pull force gauges shall be used to perform the functional test on mechanical snubbers in the field and should have their calibration checked after each functional test performance to reduce the risk of having to retest snubbers, especially in the drywell, from gauges being found out of calibration after extended use. The use of two gauges will also preclude having to retest mechanical snubbers due to the failure of one of the gauges.

E. If snubber end attachments are removed, from the snubber, for functional testing and a torque wrench is used to reinstall them, the torque wrench shall be post-use calibration checked after each torque performance to reduce the risk of having to retorque the end attachments, especially in the drywell, if the torque wrench is found out of calibration after extended use.

7.13 SI Performance Team and Facilities

A. Prior to the RFO, manpower requirements must be determined to include the following:

1. Test director
2. Assistant/backup test director (outage snubber coordinator)
3. Functional test performance personnel (teams include technician or engineer and craft personnel)
4. Visual examination personnel (may be performed by craft personnel with review of possible anomalies by technician or engineer)
5. Hydraulic snubber test performance personnel (machine operator and craft personnel with engineering oversight)
6. Hydraulic snubber rebuild personnel (performed by craft/contract personnel with engineering oversight)
7. Computer data base entry personnel (engineer or technician)

B. Facilities should be made available to include the following:

1. Office space sufficient to coordinate snubber program team meetings with area to spread flow drawings, etc.
2. Test and rebuild facility with enough room for desk, file cabinet, two test benches, control center, 2 rebuild tables, tool boxes (with an assortment of hand tools and wrenches) and other required equipment, monorail(s) or other appropriate equipment to move snubbers around the facility and a fluid storage area with fire proof cabinet.
3. Personal computer with snubber tracking data base.

7.14 Training and Qualification of Performers

A. General

1. Thorough briefings should be conducted on SI performance of visual inspections and functional testing.

2. Cognizant personnel must be qualified as test director in accordance with plant administrative procedures.

3. Appropriate GET training (including respirator training) should be received by test personnel to perform the SI.

4. GET training for contract personnel should be arranged to minimize expense and expedite getting on and off site.

5. Specific training requirements will be described under each section.

The training is performed to meet INPO, general regulatory requirements, and good business practices.

B. Visual Examinations

1. The training for the visual exams should include orientation to the requirements of the Surveillance Instructions. Training aids should include actual snubbers and examples of discrepancies that should be noted on the data sheets for further review.

2. Personnel performing the visual inspections of 2-SI-4.6.H-1 and 3-SI-4.6.H-1 must meet the visual acuity requirements of ASME Section XI, Code, 1995 Edition, 1996 Addenda, Paragraph IWA-2321.

3. Personnel performing the visual inspections of 1-SI-4.6.H-1 must meet the visual acuity requirements for mask fit.

7.14 Training and Qualification of Performers (Continued)

C. Functional Tests of PSA Mechanical Snubbers

1. The training for drag force testing PSA snubbers, in the field, should include orientation on the operation of the snubber and the drag force effect on the piping. Actual snubbers and force gages should be demonstrated and used by the students to learn the proper technique of applying the force very gradually and moving the snubber slowly through its stroke. The entire requirement for stroking and as-left testing should be included. The need to obtain the actual value when the screening value is exceeded should also be emphasized.

2. The method of determining activation should be discussed, demonstrated, and practiced by the students.

D. Functional Tests of Hydraulic Snubbers

The operation of the test machines or test benches requires extensive training on the operation of the specific piece of equipment and thorough knowledge of the snubber design and test parameters. The best results should be obtained using engineers or technicians who may be assigned to the program on a continuing basis. Since this training should be performed by the test bench manufacturer or another qualified person, the training costs will be high, inefficient performance during outages, and invalid rejects may result when different personnel are used.

E. Rebuilding Hydraulic Snubbers

The rebuilding of hydraulic snubbers is typically assigned to personnel who are familiar with the requirements through experience. Additional basic training is required for personnel who have not previously rebuilt hydraulic cylinders and control valves. The training should include classroom instruction, practical demonstration and practice in the actual rebuilding of snubbers. Most of the training at Browns Ferry has been performed as On-the-Job Training (OJT) by personnel who are very familiar with the rebuilding of snubbers.

7.14 Training and Qualification of Performers (Continued)

F. Rebuilding PSA Mechanical Snubbers

The PSA mechanical snubber is a complex mechanism and the manufacturer recommends they provide the training. The manufacturer will issue a rebuild training certificate, which is required to be renewed every two years. Some vendors have been authorized by the Original Equipment Manufacturer (OEM) to provide the training and some of those in TVA who have taken the training may be qualified to teach others. The rebuilding requires careful attention to many details and precision measurement in some cases. The training should include classroom instruction, practical demonstration, and practice in actual rebuilding. Special tooling is required and post maintenance tests shall be included to verify the rebuilding has been performed correctly. Browns Ferry does not rebuild mechanical snubbers, at this time, due to the extensive training and cost of purchasing and storing spare parts.

7.15 Visual Examination Program

The following applies to the regulatory requirements of safety-related and quality-related snubbers only. Other aspects of the program are contained in the section on “Balance of Plant Hydraulic and Mechanical Snubbers.”

A. Scope and Frequency

1. This program covers safety-related and quality-related snubbers, of which ASME Section XI snubbers are a subset. The visual examination shall verify that:

    a. There are no visible indications of damage or impaired operability.
    b. Attachments to the foundation or supporting structure are functional.
    c. Fasteners for attachment of the snubber to the component and to the snubber anchorage are functional.

7.15 Visual Examination Program (Continued)

A. Scope and Frequency (Continued)

2. Safety-related snubbers require visual examinations on an interval determined by the number of unacceptable snubbers found, during the visual examination process, using Table 3.7.4-1 in the Technical Requirements Manual TR 3.7.4. The basis of this frequency is provided in NRC Generic Letter 90-09. Removal of insulation is not required. Each time the performance is required the total population of the snubbers in the accessible or inaccessible category are required to be examined. The change in the frequency table described in the TRM requires that all the snubbers be examined either as separate categories or combined into one population. The table is more favorable if the snubbers are considered one population, and that usually is the choice that should be made and documented before the examinations begin.

3. At Browns Ferry the decision has been made to count all snubbers as one category and this decision is documented in the unit specific SI. Based on past examinations, the results should permit skipping alternate outages and permit an interval between examinations up to 48 months.

B. Visual Inspection Package

1. This package is the SI procedure and should be performed by locations, with ALARA considerations in mind, to minimize time spent or re-traveling through high radiation areas.

2. In the process of performing visual examinations, special attention should be given to potential problems of snubbers which must be functionally tested, i.e., scaffolding/ladder required, total removal required, high radiation levels, etc.

C. Examination Items

The examination items are specified in the TRM. Additional detail shall be provided in the Surveillance Instructions. A check list of the items to be observed are clearly specified and data sheets have been developed to document examination results. These data sheets are located in Attachment 2 of the appropriate SI. The Surveillance Instruction requires the completion of Attachment 2 for each snubber visually examined.

7.15 Visual Examination Program (Continued)

D. Resolution of Anomalies

Many discrepancies can be found during the exams, but few actually result in inoperability of the snubber. All of the anomalies should be reviewed and dispositioned by an individual very knowledgeable in the operability requirements of the snubbers. A case of low fluid level may be resolved by functional test to verify the snubber will activate, followed by resolution of the leak. If a reservoir is found completely empty, the snubber shall be declared inoperable until a functional test has been performed, the results found acceptable and the leak has been resolved. Mechanical snubbers that are suspected of being bound up may be stroke tested to verify they are not bound up. Most other anomalies will require minor maintenance, if any action at all. All anomalies shall be handled in accordance with SPP-3.1, Corrective Action Program.

7.16 Decontamination

A. General Considerations

1. Since the Snubber Rebuild and Test Facility is located in the Turbine Building, any snubber transported to the facility must satisfy RADCON requirements.

2. Therefore, sometimes decontamination of snubbers may be necessary. A major consideration in decontaminating snubbers is avoiding changing the as-found condition (i.e., stroke setting) of the snubbers selected for as-found testing. Therefore, the ability to test the snubbers with a minimum amount of decontamination is desirable, but the inconvenience of testing and rebuilding contaminated snubbers can add significantly to the cost and time required for testing to be completed.

B. Decontamination of Mechanical Snubbers

1. Mechanical snubbers are not water-tight. Where possible, these snubbers should be decontaminated by wiping with a dry cloth or using a foam cleaner rather than immersion into a cleaning fluid. Fluid that has entered the snubber may become trapped and eventually cause corrosion. Unless the snubber has been subjected to intrusion of contaminated fluid, the inside of the snubber should be free of contamination.

7.16 Decontamination (Continued)

C. Decontamination of Hydraulic Snubbers

1. Hydraulic snubbers are more resilient than mechanical snubbers. The only time a hydraulic snubber may have problems during decontamination is if high pressure water is used to remove the contamination. If this occurs care should be taken not to spray directly at the front rod wiper. The water pressure could force water past the rod wiper and the piston rod packing, since these seals are made to pressurize from the inside of the snubber. Water which has been forced into the snubber could affect the functional test results.

2. Decontamination of hydraulic snubbers should be carefully controlled, especially for those that have a suspected low fluid level and supplied by a gravity feed reservoir. If the fluid used to decontaminate the snubber seeps into the reservoir, or the reservoir is disassembled, the as-found fluid level is changed before the test is performed. For any snubber that is not scheduled for rebuild, the effects of the decontamination process should be thoroughly evaluated to determine whether the snubber should be disassembled to remove any fluid that might have entered. There should never be a need to disassemble a reservoir for decontamination. The vent hole in the reservoir of a gravity fed snubber is so small it should not allow contamination to enter, since it is always at the high point. Contamination usually falls instead of rising as it would have to do to infiltrate the reservoir.

7.17 Functional Test Program Guidelines

Any newly added, replacement, or refurbished snubber should be tested in accordance with the applicable functional testing Surveillance Instruction prior to installation. Once the functional test has been performed it remains acceptable for 1 year after completion, unless something happens or there is a concern about the snubber.

Functional tests are performed each operating cycle to meet Technical Surveillance Requirements TSR 3.7.4.2 verifying, by sampling 10% of each subcategory of snubber, that the safety-related or quality-related snubbers are operable. For each failure to meet the functional test acceptance criteria an additional 10% of the remaining snubbers in the subgroup shall be tested, until no additional failures occur. In addition to the required sampling, snubbers on service life monitoring and balance-of-plant programs should be addressed. Specific Technical Requirements are given in the appropriate functional testing SI.

When PSA mechanical snubbers can be stroked in an approximately horizontal position, they do not have to have both pins removed to perform the test. Except for Torus Dynamic Restraint snubbers, when test in-place techniques are used, hydraulic snubbers must be removed from their installed location and taken to a test bench for testing.

When the required 100 percent visual exam is also to be performed for the operating cycle, it should be performed before the functional tests are performed. When the 100 percent visual exam is not required, a visual check of the snubber for indication of service-related degradation or damage of the snubber installation should be made before the snubber is disconnected or removed. This is a good preventative maintenance practice and not a SI visual examination requirement.

7.17 Functional Test Program Guidelines (Continued)

A. Functional Test Packages

1. Test packages should be prepared for each individual snubber to be tested and should include the following:

   a. Marked-up flow diagram to illustrate the snubber location in the system for Shift Manager/Unit Supervisor's review and approval.
   b. Shift Manager/Unit Supervisor's authorization for snubber removal.
   c. Configuration Control Drawing (CCD) or Design Change Authorization (DCA), approved for use by Site Engineering (Civil), depicting the current physical configuration.
   d. Inservice Inspection (ISI) location drawing, if appropriate.
   e. Notes of any special considerations such as scaffold or ladder requirements.
   f. SI procedure, including data sheets.
   g. Removal and Reinstallation procedure, including data sheets.
   h. Calibration sheets for all M&TE used for this Work Implementing Document.

B. Functional Testing of PSA Mechanical Snubbers

BFN Technical Requirements require drag force measurements and activation verifications.

Mechanical snubber functional testing is performed to verify two characteristics - Activation and drag force. If a mechanical snubber is tested in the field the test is performed using 2 Push-Pull force gauges. The snubbers are tested 3 times in each direction and the results of the 3 test are averaged. This is performed in both the extension (tension) and retraction (Compression) directions. This is considered to be a qualitative testing method.

The qualitative test (verification that activation takes place, without pulling a value on the activation level) is based on the expectation that the activation level will not drift out of its acceptance range through the life of the snubber. Exceeding the acceptance range would result from broken or disconnected parts and would be detected in a qualitative test. The low end extreme of the range is exemplified by a locked up or jammed snubber.

7.17 Functional Test Program Guidelines (Continued)

B. Functional Testing of PSA Mechanical Snubbers (Continued)

A broken capstan spring or internal contamination could cause such problems. There is only an upper limit that the acceleration not exceed 0.02 g's, with no specified lower limit. Pacific Scientific Company (PSC) performed qualification tests on new snubbers and performed tests on snubbers that have been in extended plant service to verify the activation level at various loads. PSC concluded that there is no significant change in activation value at any level of rated load of the snubber.

Performing a quantitative test of activation of PSA snubbers requires a specialized test machine. BFN has a computer controlled API/Barker STB-200 snubber test bench. The test bench is capable of testing any size PSA snubber and most medium and small bore hydraulic snubbers. The software performs four basic functions:

- Operator interface
- Machine control
- Data acquisition and conversion
- Data analysis and presentation

Test results are presented in the form of a graph with maximum and average test values. The printout is easy to read and understand.

1. Visual Examination (VE)

   Perform the VE according to the SI if the VE SI is scheduled for the current operating cycle. Otherwise, perform the visual check to determine overall integrity of the snubber.

2. Activation Test

Activation is determined by starting with the most stroke available. Stroke the snubber gradually and then attempt to rapidly increase the speed of the stroke. Marked resistance to the attempt to increase the speed should be encountered. Also, activation may be confirmed by the hearing of a clicking noise during the rapid increase. This clicking noise is caused by the ears of the capstan spring contacting the inertial mass. The snubber should be slowed to a stop before reaching the end of its stroke. Repeat the check in the other direction of travel.

7.17 Functional Test Program Guidelines (Continued)

2. Activation Test (Continued)

   Resistance to rapid increase in speed indicates the parts are connected inside the snubber and activation is taking place. If resistance to rapid increase in speed is not detected, the snubber may be tested on a test bench.

3. AS-Found and As-Left Drag Force Test

   Drag force is the minimum force required to initiate or maintain motion of the snubber. The drag force of any snubber should not over-stress the supported system/component. The snubber manufacturers recommended drag force value is 5% of the rated load for an NF mechanical snubber. That is taken as a screening value and larger values are evaluated on a case by case basis when found. Higher generic screening values might be obtained with piping system reanalysis. Refer to General Engineering Specification G-43 for mechanical snubber drag force requirements.

   This test is performed to verify the drag force of the snubber will not exceed 5% of the snubber rated load. An exception to this 5% of the rated load requirement is made when considering PSA ¼ snubbers. In accordance with information from PSC, the PSA ¼ snubber (Design Rated Load (DRL) - 350 lbs.) is evaluated to the same requirements as the PSA ½ (DRL - 650 lbs.) from a design load consideration. As determined by PSC, drag forces greater than 5% is indicative of impending snubber failure.

   If the drag force of the snubber is acceptable during the As-Found testing it may be used for the As-Left test results. For As-Found drag forces that exceed 4% but are less than 5%, the snubber should be stroked several times in an attempt to redistribute the grease and reduce the drag.

   The snubber should then be retested for drag. If the drag force does not reduce significantly (2% - 3%), the snubber should be replaced. If the drag force is significantly reduced, the snubber should be reinstalled and retested during the next operating cycle.

7.17 Functional Test Program Guidelines (Continued)

3. AS-Found and As-Left Drag Force Test (Continued)

PSC has provided instructions for removing excess or dried grease from the snubbers by partially disassembling them and stroking in a solvent. If normal stroking results in an acceptable drag force, replacement or disassembly of the snubber should be avoided.

C. Functional Testing of Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers

The large size and difficult-to-remove snubbers, such as the Torus Dynamic Restraint snubbers, may be tested more economically in place, using machines designed for that purpose. The functional tests can be performed to determine lockup velocities, bleed rates, and seal integrity with the removal of only one pin. This functional testing will be performed by a contractor as BFN does not have a test machine with these capabilities. As with other snubbers this functional testing is performed in both the Extension (Tension) and Retraction (Compression) directions for lockup and bleed. Seal integrity is performed against the blind end and the rod end.

The smaller hydraulic snubbers are removed from the installed location, decontaminated, if necessary, and taken to the test bench for testing. As with other snubbers this functional testing is performed in both the Extension (Tension) and Retraction (Compression) directions for lockup and bleed. The computer controlled API/Barker STB-200 snubber test benches are capable of testing all Bergen-Paterson, Anchor/Darling, Fronek or Grinnell hydraulic snubbers. The benches are easy to operate and the software is user friendly. The test results, i.e. lockup (activation) velocity, bleed (release) rate, and drag force are presented in the form of a graph with maximum and average test values. The printout is easy to read and understand. The graphs are to be placed with the SI functional test package and sent to the Electronic Document Management System (EMDS).

1. Visual Examination (VE)

Perform the VE according to the SI if the VE SI is scheduled for the current operating cycle. Otherwise, perform the visual check to determine overall integrity of the snubber.

7.17 Functional Test Program Guidelines (Continued)

C. Functional Testing of Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers (Continued)

2. AS-Found and As-Left Lockup (Activation) and Drag Force Test

   Lockup (activation) velocity and bleed rate should be in accordance with the acceptance requirements of the applicable functional test Surveillance Instruction.

   The drag force of any snubber should not over-stress the supported system/component. The snubber manufacturers factory or recommended drag force value is 2% of the rated load of an NF hydraulic snubber. That is taken as a screening value and larger values are evaluated on a case by case basis when found. Higher generic screening values might be obtained with piping system reanalysis or evaluation performed by Site Engineering (Civil).

3. Replacement of Torus Dynamic Restraint Snubbers

   If a Bergen-Paterson Torus Dynamic Restraint fails to pass its functional test acceptance criteria, the restraint shall be replaced with a new Lisega Torus Dynamic Restraint.

7.18 Rebuilding of Hydraulic Snubbers

Rebuilding of hydraulic snubbers shall be performed by task qualified and trained persons. Hydraulic snubbers shall be rebuilt in accordance with the following procedures, MPI-0-000-SNB001, Hydraulic Shock and Sway Arrestor Grinnell Unit Disassembly and Reassembly and MPI-0-000-SNB002, Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, Fronek Unit Disassembly and Reassembly, as appropriate.

7.18 Rebuilding of Hydraulic Snubbers (Continued)

A. Hydraulic Rebuild Packages

1. Rebuild packages should be prepared for each individual snubber to be rebuilt and should include the following , as a minimum:

a. Removal and Reinstallation procedure, including data sheets.
b. Functional test SI procedure, including data sheets.
c. Appropriate rebuild procedure, including data sheets.
d. Shift Manager/Unit Supervisor's authorization for snubber removal.
e. Description, serial number, UNID, location history and the Work Implementing Document (WID) which removed the snubber, if the snubber was stored in the snubber test/rebuild facility.
f. Copy of the purchase contract, if the snubber was bought out of Nuclear Stores.
g. Completed ASME Section XI paperwork and NIS-2 forms.
h. Marked-up flow diagram to illustrate the snubber location in the system for Shift Manager/Unit Supervisor's review and approval.
i. Configuration Control Drawing (CCD) or Design Change Authorization (DCA), approved for use by Site Engineering (Civil), depicting the current physical configuration.
j. Inservice Inspection (ISI) location drawing, if appropriate.
k. Notes of any special considerations such as scaffold or ladder requirements.
l. SI procedure, including data sheets.
m. Removal and Reinstallation procedure, including data sheets.
n. Calibration sheets for all M&TE used for the WID.
o. PIC ticket or 575 for the seal kit, any new parts required and hydraulic fluid.

7.19 Evaluation of Degraded and Failed Snubbers

A. Degraded Snubbers

1. General Information

By the criteria established, degraded snubbers, are capable of performing their design basis function(s) and therefore have no effect on the system/component ability to perform its design basis function(s). (i.e., there are no Operability issues with degraded snubbers).

There are several items which can cause both mechanical and hydraulic snubbers to be in a degraded condition. These are as follows:

- Cotter pins missing or installed but legs not sufficiently bent to prevent the pin from backing out.
- Pivot pin retaining ring missing.
- Security locking devices (i.e., locking tabs or wire) on the snubber attachment bolts missing, if required.
- Spacers missing, leaving excessive gap on one side of the clevis.

When any of these conditions are found a Problem Evaluation Report (PER) should be written and the condition is to be corrected to prevent a more serious condition or cause a failure of the snubber in the future.

2. Mechanical Snubbers

Drag force is the only criteria which has a degraded category. The degraded category, for the drag force, is considered to be between 2% and 5% of the snubbers rated load.

- If the snubber drag force is less than or equal to 2% of the snubbers rated load, the snubber may be reinstalled in its location without any further evaluation.
- If the snubber drag force is above 2% but less than or equal to 5% of the snubbers rated load, the snubber shall be evaluated for impending failure and may either be reinstalled or replaced, upon the outcome of the evaluation.

7.19 Evaluation of Degraded and Failed Snubbers (Continued)

A. Degraded Snubbers (Continued)

2. Mechanical Snubbers (Continued)

- If the snubber drag force is found to be above 5% of the snubbers rated load, the snubber shall be declared as a functional failure and replaced. Also a Problem Evaluation Report (PER), an engineering failure analysis and a supported system/component analysis shall be completed.

3. Hydraulic Snubbers

The following conditions are considered as degradations for hydraulic snubbers:

- Pits, scratches, or rough areas observed on the piston rod that would not contact the piston seals.
- Fluid reservoir being below the minimum level, based on the temperature, but not empty.
- Minor leaks which have not reduced the volume of the reservoir below the minimum required.
- Minor rust or corrosion on the body of the snubber.

When any of these conditions are found a Problem Evaluation Report (PER) should be written and the condition corrected to prevent a more serious condition or cause a failure of the snubber in the future.

7.19 Evaluation of Degraded and Failed Snubbers (Continued)

B. Failed Snubbers

1. General Information

A failed snubber is "GENERALLY" considered as not being able to perform the design basis function of the snubber. However, for the specific location even a failed snubber may be capable of performing its design basis function.

If the failure was found as part of the Technical Requirements Manual initial or any subsequent samples the following is the minimum required testing expansion:

- Expand the sample by 10% of the remaining snubbers in the subgroup, and
- If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and
- If the cause is a generic manufacturing defect, test all snubbers of that same type, and
- Identify and test all other snubbers suspected of the same failure mode.

If the failure was found outside of the Technical Requirements Manual initial or any subsequent samples (i.e., other maintenance activity, testing directed/requested by the Snubber Engineer, Service Life Monitoring testing, testing of snubbers on non-Technical Specification or Technical Requirements Manual systems, etc.) the following is the minimum required testing expansion:

- If the cause of the failure is determined to be a system transient, test all snubbers on that system, which could have been affected by the transient, and
- If the cause is a generic manufacturing defect, test all snubbers of that same type, and
- Identify and test all other snubbers suspected of the same failure mode.

7.19 Evaluation of Degraded and Failed Snubbers (Continued)

B. Failed Snubbers (Continued)

2. Failure Analysis

When a snubber fails to meet the functional test acceptance criteria, an engineering evaluation shall be made to determine the cause of the failure, as required by TSR 3.7.4.3. The results of this evaluation shall be used , if applicable, in selecting snubbers to be tested in an effort to determine the OPERABILITY of other snubbers irrespective of the type which may be subject to the same failure mode. This evaluation may also be used by Site Engineering (Civil) when they are required to perform a supported system/component analysis.

During the failure analysis of hydraulic and mechanical snubbers, the performance should be very slow and methodical.

Hydraulic snubbers typically fail because of loss of fluid, which results in no restraining action. This is referred to as failing soft. Some types of snubbers are prone to fail from a loss of bleed capability. This will be of affect only if the snubber has been activated. The failure analysis is to determine the reasons these conditions developed. Appendix I provides many very good points to be investigated during the analysis of hydraulic snubbers and their component parts, but this Appendix should not be viewed as all inclusive.

PSA mechanical snubbers typically fail from high drag forces that approach or are in the locked up condition. That condition requires a supported system/component analysis to determine the affect on the piping system or component from restriction of the thermal movement, in addition to the analysis to determine the cause of the high drag or locked up condition. Appendix I provides many very good points to be investigated during the analysis of mechanical snubbers and their component parts, but this Appendix should not be viewed as all inclusive.

7.19 Evaluation of Degraded and Failed Snubbers (Continued)

B. Failed Snubbers (Continued)

3. Failure Cause Determination Techniques

Sometimes the cause of the inoperable condition can be determined by external examination, such as loose tubing connections or paint in the wrong places (i.e., on the moving parts). However, in most cases the snubber will require disassembly to determine what caused the condition. Visual examinations and measurements, coupled with the knowledge of what is required to keep the snubber operable are usually sufficient to determine what caused the condition. Sometimes additional knowledge is required to determine whether a part broke from an overload or fatigue, or broke in tension or compression, etc. Additional investigation is usually required to determine what caused the defect to develop. Such root causes may be improper maintenance, improper design or operation resulting in excessive vibration of the supported system/component.

7.20 Supported System/Component Analysis

A. Mechanical Snubbers

The drag force of the snubber should not overstress the supported system/component as a result of thermal expansion or contraction. The snubber manufacturer's recommended limiting drag force is 5% of the rated load of the snubber. However, that value is applicable only to the functionality of the snubber. The structure, component, piping, or equipment that the snubber is supporting must be evaluated for high drag forces to ensure they have not been overstressed beyond their allowable limits. Refer to General Construction Specification G-43 for screening values based on pipe size to determine when a supported system/component analysis is required.

7.20 Supported System/Component Analysis (Continued)

B. Hydraulic Snubbers

The drag force of the snubber should not overstress the supported system/component as a result of thermal expansion or contraction. The snubber manufacturer's recommended limiting drag force is 2% of the rated load. However, that value is applicable only to the functionality of the snubber. The drag force of a hydraulic snubber will not overstress the pipe, but an analysis is required since the snubber failed its functional test acceptance criteria. General Engineering Specification G-43 gives screening values based on pipe size to determine when a supported system/component analysis is required. The G-43 values have not been accepted at Browns Ferry for hydraulic snubbers at this time.

A supported system/component analysis is required if the snubber failed the functional test acceptance criteria for activation and bleed.

7.21 Performance Monitoring and Trending

A. General Approach

The performance of snubbers is indicated by the results of the functional tests. The snubber tracking data base program is the primary means for tracking and trending of snubber performance. Some short term tracking is required by the Technical Requirements Manual relating to snubbers installed in the same location as other snubbers that failed during previous outage tests due to location or unknown causes. These snubbers are required to be tested during the next operating cycle if the failure was due to location or design deficiencies. Other manual tracking can be performed by referencing the functional test data sheets from previous outages; however, this tracking can be performed more efficiently if historical snubber tracking data base information is available.

When the same snubber has been tested several times, its results may be reviewed to determine whether a trend may be developing in the results. Appendix G provides additional guidance for the performance monitoring and trending of snubbers.

7.21 Performance Monitoring and Trending (Continued)

B. Trending for Hydraulic Snubbers

The test results that are significant for trending are the activation velocity and the bleed rate. Typically the snubber is rebuilt and as-left tests are performed to set the values in the optimum portion of the acceptance range. The results of the next as-found test should be compared to the last as-left test to determine any drift that has taken place. If the drift is consistent, the optimum setting might be changed to keep the as-found tests better in the acceptance range. If a snubber has not been rebuilt, the results of the next as-found test should be compared to the last as-found test to see if the acceptance range is degrading with the increased stay time.

C. Mechanical Snubber Performance Trending

1. Currently drag force is the only performance parameter that is measured during the snubber functional tests. Changes in drag force can take place for a number of reasons and there is no set pattern known to be specifically predictable. When high drag forces are caused by excessive or hardening lubricant, stroking the snubber can cause a redistribution of the lubricant, resulting in reducing the drag forces. The drag force may remain relatively low for a number of years when the lubricant is redistributed. Corrosion can be broken loose by stroking, but is usually progressive, and the drag force can be expected to increase again soon.

   Snubbers that are identified for service life monitoring are actually primarily monitored for performance, with increasing drag forces taken as an indication of impending failure of the snubber. Snubbers that are not identified for service life monitoring should also be reviewed for previous test results to determine whether the trend is upward and some preventive maintenance is advisable to avoid the requirement of having drag forces above the screening criteria evaluated. Snubber drag forces between 4 to 5 percent of rated load should be evaluated for impending failures.

7.21 Performance Monitoring and Trending (Continued)

C. Mechanical Snubber Performance Trending (Continued)

2. While it is not currently required to determine the acceleration limit of the PSA snubbers, an upward trend in the drag force will effectively result in lowering the acceleration value, and there is no lower limit to the acceleration value. The concern with a locked up snubber is possible over-stressing of the supported system/component under normal loading conditions. During a seismic event the snubber will act as a rigid strut, effectively limiting the dynamic response within the load limit of the snubber. Some testing has indicated in some snubbers a slight upward trend in the acceleration value due to wear, but all results are within the 0.02 g's limit. Any performance monitoring of acceleration should be carefully evaluated using other plants and PSC test program results to determine its value.

7.22 Service Life Monitoring

A. Regulatory Requirements

The TR requires that the service life of hydraulic and mechanical snubbers be monitored to ensure that the service life is not exceeded between surveillance inspections. The object is to replace degraded components before they become inoperable. Service life varies with conditions and materials, and should be adjusted based on actual experience. Appendix G, of this procedure , provides additional guidance for a complete service life monitoring program.

B. Hydraulic Snubber Service Life Program

The static and dynamic seals, moving parts and fluid are subject to wear or other degradation. Hydraulic snubbers at Browns Ferry have ethylene propylene seals. The ethylene propylene seals at Browns Ferry have an established nominal service life of 17.3 years. Balance of plant hydraulic snubbers may be treated the same as safety-related snubbers for seal life extension.

The piston, piston rod, cylinder, and glands are also subject to wear, especially in high vibration installations. Those, and other moving parts of the snubber, should be examined carefully each time the seals are replaced, and replacements made to prevent leakage or other conditions of in-operability before the next time the snubber is to be rebuilt.

7.22 Service Life Monitoring

B. Hydraulic Snubber Service Life Program (Continued)

The fluid, if to be reused, should be checked at the rebuild time for moisture content and particulate content to determine whether it should be filtered to bring it within the specifications.

C. PSA Mechanical Snubber Service Life Monitoring

Drag force increase is not a reliable indicator of the remaining service life of the PSC snubbers, but it is the best indicator identified to date. Therefore, service life efforts involve tracking drag force variations.

7.23 Balance of Plant Hydraulic and Mechanical Snubbers

A. Snubbers installed in non-safety-related or non-quality-related applications are included in the Preventive Maintenance (PM) program for performance of visual examinations and functional tests on a basis subject to review and adjustment based on the results. Both hydraulic and mechanical snubbers will be included in the PM program.

B. Hydraulic snubber visual exams should be performed for fluid level and obvious problems frequently enough to assure the fluid level stays within the operability range. Snubbers should be examined for fluid level the next outage after they have been rebuilt, and the next exams scheduled based on the results and past experience. Balance of plant snubbers installed in similar environmental conditions as safety-related snubbers may be used to verify extension of seal life for the safety-related snubbers. Functional tests should be performed on a percentage and frequency based on the results of the safety-related snubber test results. A low failure rate would indicate an extended interval between tests and possibly a small sample would be appropriate.

C. The mechanical snubbers should be examined for signs of overload, abuse, and corrosion. The exams should be performed based on the environmental conditions and the activities performed in the area. A functional (activation or drag force) test or hand stroking, whichever is needed to confirm adequate freedom of movement, should be performed on suspect snubbers, and a sampling program should be considered.

7.24 Dynamic Transients

In the event of a water hammer or an unanticipated transient, the following inspection and testing shall be performed to determine snubber operability. A Work Order (WO) is not required for a visual examination, but is required for performance of any functional testing or hand stroking required.

A. Visually inspect all snubbers and snubber supports that have been subjected to the transient. The visual inspection shall be performed in accordance with 1-, 2-, or 3-SI-4.6.H-1, as applicable.

B. If the visual inspection reveals damage to the snubbers or to the snubber supports manually stroke all mechanical snubbers, that have been subjected to the transient, to their full range of travel. Also perform in-place drag force testing in accordance with 0-SI-4.6.H-2A.

C. If no visible damage to the snubber or snubber support is determined, then manually stroke 10% of the snubbers that have been subjected to the transient and perform in-place drag force testing in accordance with 0-SI-4.6.H-2A.

D. If any snubber is found to be unacceptable then an additional 10% of the snubbers, subjected to the transient, shall be tested until no failure is found or all snubbers, subjected to the transient, have been tested.

E. Perform a failure analysis for each failed snubber to determine failure mode.

F. Testing of hydraulic snubbers is not required since internal damage to the hydraulic snubber in not likely to occur.

7.25 Snubber Users Group (SNUG)

A. SNUG Organization Formation and Purpose

SNUG was formed in the winter of 1984 as an information sharing group which addresses industry snubber concerns including maintenance, regulation, and surveillance. SNUG does not formally address licensing concerns and vendors will not be allowed membership. The only membership requirements are that a utility must actively participate in the SNUG data base information exchange and a small fee, as designated by the Board of Directors. Each utility is requested also to select two designees at each plant and/or utility as primary and secondary contacts. Further information concerning SNUG may be found in the SNUG "By-Laws" and "Policy Statements".

8.0 ACCEPTANCE CRITERIA

In accordance with the applicable and appropriate Maintenance and Surveillance Instructions.

9.0 APPENDICES

APPENDIX A: Snubber Request for Relief 3-SI-2

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SNUBBER REQUEST FOR RELIEF

This relief request was approved by the NRC per Reference L and will be implemented during the Unit 3 Cycle 9 refueling outage.

SUMMARY:

Pursuant to 10CFR50.55a(a)(3)(i), TVA is requesting relief from the identified ASME Section XI requirements related to examination and testing of snubbers. TVA proposes to continue use of the examination and testing plans currently defined in the Technical Requirements Manual (TR 3.7.4). The current Technical Requirements Manual requirements have been promulgated, accepted, and approved (on July 14, 1998 for Browns Ferry Plant, Units 1, 2, and 3) by NRC, while ASME Section XI imposes overlapping requirements which do not enhance the quality and safety of the subject snubber examination and testing.

COMPONENTS:

Component/piping snubbers

CODE CLASS:

1, 2 and 3

CODE REQUIREMENT:

1981 Edition of ASME Section XI (no addenda)

IWF-5300(a) and (b) inservice examination and testing in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4.

IWF-5400 Repairs and Replacements of snubbers shall be in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4.

IWA-6230 requires inservice inspection summary reports for snubbers be filed with regulatory authority.

IWA-2110 requires Authorized Nuclear Inservice Inspector (ANII) involvement for snubber examination and testing.

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CODE REQUIREMENT FROM WHICH RELIEF IS REQUESTED:

In accordance with 10CFR50.55a(a)(3)(i), relief is requested from the ASME Section XI, 1989 Edition (no addenda), requirement for inservice examinations and tests for snubbers, and repair/replacement examinations and tests of snubbers:

a) IWF-5300(a) and (b) Inservice Examination and Testing, and implied OM-1987, Part 4, Sections 2.3, Inservice Examinations, 2.4, Examination Documentation, and 3.2, Inservice Operability Testing, and 3.3, Testing Documentation.

b) IWF-5400 Repairs and Replacements of snubbers shall be in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, Sections 1.5.6, Snubber Maintenance or Repair, and 1.5.7, Snubber Modification and Replacement.

c) IWA-6230, Summary Reports (for snubbers).

d) IWA-2110(a)(5) and (c), Duties of the Inspector (for involvement for snubber examination and testing).

BASIS FOR RELIEF:

ASME Section XI Class 1, 2, and 3 equivalent snubbers are examined and tested in accordance with Browns Ferry Nuclear (BFN) Plant Technical Requirements Manual (TRM), TR 3.7.4. BFN TR 3.7.4 is prepared in accordance with the guidance given by NRC in Generic Letter 90-09. The scope for snubbers examined and tested in accordance with TR 3.7.4 is not limited by line size or other applicable code exemptions and includes a numerically greater population of snubbers than the Section XI program. Examination and testing of the snubbers in accordance with both ASME Section XI and the plant TRM would result in duplication of effort utilizing different standards and require the preparation of a separate program and associated procedures. This would result in additional cost and unnecessary radiological exposure. In addition the personnel performing snubber visual examinations would also be required to be certified in accordance with the American Society of Nondestructive Testing (ASNT) SNT-TC-1A " Personnel Qualification and Certification in Nondestructive Testing", which is an additional certification as compared to the task training qualification required to perform the TRM required examinations and testing of snubbers. The existing TRM program for examination and testing of snubbers was promulgated, accepted, and approved by NRC.

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BASIS FOR RELIEF: (Continued)

The implementation of OM-1987, Part 4, would require BFN to initiate a snubber examination and testing program that is more complicated and expensive to perform, without a compensating increase in the level of quality and safety.

ALTERNATE EXAMINATIONS:

The BFN TRM, TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities. The procedures utilized for these examinations are: 3-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers"; 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers"; 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson Hydraulic Snubbers"; 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"; 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraints"; MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Paterson Unit Disassembly and Reassembly"; and MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers". This will include the pin-to-pin area inclusive of applicable snubbers.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers".

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the site corrective action program, SSP-3.1, and the implementing procedures (3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported will remain in the ASME Section XI examination boundary.

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JUSTIFICATION FOR THE GRANTING OF RELIEF:

The current program, as defined by TR 3.7.4, provides for a level of quality and safety equal to or greater than that provided by OM-1987 Code, Part 4, and utilizes NRC guidance not incorporated in the OM Code referenced by the 1989 Edition of ASME Section XI.

Examination, testing, repair and replacement of snubbers is currently performed in accordance with TR 3.7.4, which utilizes the guidance provided by NRC in Generic Letter 90-09. The OM Code referenced by ASME Section XI has a different basis for examination (failure mode groups) and test plans (10%, 37, or 55). It is impractical to implement both plans because of the resulting duplication of examination and testing efforts and different requirements for snubber quantities subject to examination or test, actually examined and/or tested, and sample expansion requirements. This would result in additional cost and unnecessary radiological exposure. The existing TRM program for examination and testing of snubbers has been promulgated and accepted by NRC. The differences in the two programs could create confusion when selecting test samples, applying acceptance criteria, corrective actions and examination schedules for failed snubbers. This situation could increase the possibility of applying the wrong action, thus creating a nonconformance, an in-operability or even a violation of a TRM requirement.

To eliminate any misinterpretation or confusion in administering overlapping requirements for snubbers, and to remove the possibility of applying contradicting requirements to the same snubber(s), BFN proposes to examine and test snubbers in accordance with BFN TR 3.7.4.

Sub-article IWF-5400 provides the requirements for repair and replacement of snubbers to be in accordance with OM-1987, Part 4, Section 1.5.6, "Snubber Maintenance or Repair" and 1.5.7, "Snubber Modification and Replacement" require repaired and replaced snubbers to meet the visual examination requirements of Paragraph 2.3.1.2 and the operability test requirements of Paragraph 3.2.1.1. Section 1.5.6 also requires an evaluation of the maintenance or repair activity and Section 1.5.7 requires a suitability evaluation on the replacement/modified snubber. TR 3.7.4 (TSR 3.7.4.6) requires replacement snubbers and snubbers which have repairs which might affect the functional test results to be tested to meet the functional test criteria prior to installation.

Maintenance procedure MPI-0-000-SNB004 provides visual examination criteria for installation of a snubber after repair or replacement. The ASME Section XI repair/replacement program at BFN documents the suitability of repairs, IWA-4130(a)(4), and replacements, IWA-7220.

JUSTIFICATION FOR THE GRANTING OF RELIEF: (Continued)

ASME Section XI, VT-3 certification required for personnel performing snubber visual examinations is an additional certification as compared with the TRM program training qualifications. Personnel performing the TRM required visual examinations are "process qualified" to perform the examinations and testing required by the TRM and implemented by the referenced procedures. This training currently includes a visual test associated with face mask fit and specific training on the acceptance criteria associated with procedure MPI-0-000-SNB004. Additional "visual acuity" verification for personnel performing snubber visual examinations will include visual acuity requirements that meet ASME Section XI. The training and documentation of personnel to the visual acceptance criteria, specified in the TRM implementing procedures, provides an acceptable level of quality and safety.

Because relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to require ANII involvement. The BFN TRM snubber program does not require the use of an ANII for examination and test requirements. The ANII will not be involved in the TRM required visual examination or testing activities performed in lieu of the ASME Code requirements. A snubber program manager provides oversight of the TRM snubber program implementation for both visual and functional testing. This oversight includes both review and evaluation of visual examination and functional testing data to ensure TRM requirements are met. The snubber program manager provides an acceptable level of quality and safety without ANII involvement in those activities. ANII involvement in other inservice repair and replacement snubber activities, as required by IWA-2110(g) and (h) and implemented by BFN's ASME Section XI repair and replacement program will be maintained.

Sub-article IWA-6230 and OM-1987, Part 4, Sections 2.3 and 3.3 provide requirements for ASME Section XI inservice examination and test documentation for snubbers and a summary report of examinations and testing. Under the alternate requirements for snubbers, there will be no ASME Section XI inservice examination and testing to document in a summary report. TR 3.7.4 is implemented by surveillance instructions 3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and maintenance instructions MPI-0-000-SNB002, and MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program, include data sheets for documenting the visual examination and functional test data and results, and provide for documentation of non conforming results and evaluation of those results. The completed data sheets are QA records and are controlled and maintained in accordance with the BFN QA records program. These records are available onsite for review and inspection.

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JUSTIFICATION FOR THE GRANTING OF RELIEF: (Continued)

The QA records documenting snubber visual examinations and functional tests provide an acceptable level of quality and safety when compared to the requirements of ASME Section XI and OM-1987, Part 4.

Based on the justification provided, BFN's examination and testing of snubbers, in accordance with TR 3.7.4 will provide an acceptable level of quality and safety. Therefore, pursuant to 10CFR50.55(a)(3)(i), TVA request that relief be granted from the 1989 Edition of ASME Section XI Code requirements related to inservice examination and testing for snubbers.

IMPLEMENTATION SCHEDULE:

TR 3.7.4 will be implemented during the second ten-year ASME Section XI inspection interval for snubber examination and testing in lieu of the code requirements listed above.

APPENDIX B
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BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC SNUBBER

1.0 GENERAL DESCRIPTION

Hydraulic snubbers consist basically of a main cylinder, main piston, fluid modulating (control valve) device and fluid makeup reservoir. Under normal operating conditions, when piping and equipment moves thermally at relatively low velocities, fluid passes from one end of the main cylinder to the other through the control valves with little or no resistance. Under dynamic conditions, at relatively high velocities, the fluid is "choked" (snubber lock up) or blocked at the control valve, allowing little or no further motion of the main piston rod other than that due to compression of the fluid and metallic parts.

BFN purchased its original snubbers from Bergen-Paterson and they were purchased as Safety-Related, NF. The Bergen-Paterson Part Numbering was primarily used which reflects the rating in KIPS of each snubber. These snubbers were manufactured in lots and not given an individual serial number, therefore Browns Ferry developed and individual serial number and stamped this number on the snubber body. This numbering system has been the means of tracking these snubbers as they have been moved from location to location.

In 1978 Bergen-Paterson revised their numbering system to the following:

2500	-	XXX	-	XXX
Model No.		Kip Rating		Sequential Unit No.

Later the numbering system was changed by Anchor/Darling to the following:

ADH	-	XXX	-	XXX
		Model No.		Sequential Unit No.

Fronek has retained the Anchor/Darling numbering system.

The Bergen-Paterson snubbers are located in all three units, but the Anchor/Darling and Fronek snubbers are only located in Units 2 and 3, at this time.

2.0 The Types and Sizes for the Bergen-Paterson, Anchor/Darling and Fronek Hydraulic snubbers:

- HSSA-3, 3 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-3 or 2500-3)
- HSSA-10, 10 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-10 or 2500-10)
- HSSA-20, 20 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-20 or 2500-20)
- HSSA-30, 30 Kips, 6 inch stroke (Bergen-Paterson part number HSSA-30 or 2500-30)
- ADH-3, 3 Kips, 6 inch stroke (Anchor/Darling part number ADH-300)
- ADH-10, 10 Kips, 6 inch stroke (Anchor/Darling part number ADH-1000)
- ADH-20, 20 Kips, 6 inch stroke (Anchor/Darling part number ADH-2000)
- ADH-30, 30 Kips, 6 inch stroke (Anchor/Darling part number ADH-3000)
- ADH-50, 50 Kips, 6 inch stroke (Anchor/Darling part number ADH-5000)
- ADH-70, 70 Kips, 6 inch stroke (Anchor/Darling part number ADH-7000)
- ADH-120, 120 Kips, 6 inch stroke (Anchor/Darling part number ADH-12000)

2.1 Test Parameters in the Snubber Test Machine Program:

The following parameters shall be verified to work on the test machine, with the associated snubbers, and the accompanying plot shall be located as close to the center of the graph as possible. If the plot does not show in the center of the graph the following parameters may be changed to center the plot and give the best looking plot available.

- **Valve Open** - This value is in percent of command output. If the operator wishes to start the valve sooner the percent value may be reduced, which will require the valve to open sooner causing the command ramp to “jump” up to an initial value and overcome the dead band.

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2.1 Test Parameters in the Snubber Test Machine Program: (Continued)

- **Valve End** - The valve end value allows the operator to set an endpoint for the proportional valve opening at less than 100 percent full open. If the operator wishes the profile to extend or reduce this value should be increased or decreased, as necessary. This value must be controlled enough so the snubber will lockup and bleed, prior to the end of the test. This value controls the ramp profile in the activation tests.
- **Ramp Duration** - This value sets the time duration of the ramp between valve start and valve end. This value may be decreased, which moves the plot to the left on the graph. In the acceleration tests this value is limited to .45 sec maximum.
- **Load Duration** - This is the time that the valve will remain at the valve end position, after the ramp time has elapsed. Adjusting this value "up" will assure that the complete test will show on the graph.

TYPE	HSSA 3	HSSA 10	HSSA 20	HSSA 30
KIP RATING	3	10	20	30
STROKE	6	6	6	6
ACTIVATION RATE	10	10	10	10
RELEASE RATE	2	2	2	2
ACCELERATION RATE	N/A	N/A	N/A	N/A
DRAG FORCE RATE	2	2	2	2
TEST LOAD	80	80	80	80
PRESSURE BOOST	100	100	100	100
VALVE START	7	8	8	8
VALVE END	15	25	25	25
DRAG SPEED	2	2	2	2
RAMP DURATION	7.0	9.5	9.5	9.5
LOAD DURATION	2.9	.4	.4	.4
BENCH (B)IG/ (S)MALL	S	B	B	B

TYPE	ADH/FRONEK 20	ADH/FRONEK 30	ADH/FRONEK 50	ADH/FRONEK 70	ADH/FRONEK 130
KIP RATING	20	30	50	70	130
STROKE	6	6	6	6	6
ACTIVATION RATE	10	10	10	10	10
RELEASE RATE	2	2	2	2	2
ACCELERATION RATE	N/A	N/A	N/A	N/A	N/A
DRAG FORCE RATE	2	2	2	2	2
TEST LOAD	80	80	80	80	80
PRESSURE BOOST	100	100	100	100	100
VALVE START	8	8	8	8	8
VALVE END	25	25	25	25	25
DRAG SPEED	2	2	2	2	2
RAMP DURATION	9.5	9.5	9.5	9.5	9.5
LOAD DURATION	.4	.4	.4	.4	.4
BENCH (B)IG/ (S)MALL	B	B	B	B	B

3.0 POPPET TYPE CONTROL VALVES

Most snubber designs use spring loaded poppet (flow sensitive check) valves to limit the velocity of the piston rod. The lockup is controlled by the size of the flats on the head of the poppet and bleed rate is controlled by small grooves cut in the bottom portion (seating area) of the poppet. The spring is calibrated to keep the poppet valve from closing on its seat until the fluid velocity past the poppet head provides enough force on the poppet to overcome the spring and close the poppet. These valves are not adjustable and the poppet or spring are required to be replaced to achieve the desired lockup or bleed rate. When the cylinder has a single ended piston rod and the flow rate from the front and rear of the piston will be different for the same piston velocity, different size poppet heads are used to close at approximately the same piston velocity in either direction of travel. The small flow also prevents a solid lock-up of the valve and potential difficulty in the relief of pressure on the valve.

If for some reason the grooves become clogged the snubber would remain a rigid strut until enough time elapsed to allow the snubber to depressurize. This could cause serious damage to the piping or equipment if thermal movements were required to take place immediately after a dynamic event.

4.0 RESERVOIRS

Hydraulic snubbers usually require a fluid reservoir for the following reasons:

- to provide makeup fluid for the volume displaced by the piston rod in single ended piston rod models.
- to compensate for thermal expansion and contraction of the fluid.
- to provide a fluid reserve in the event of low level fluid loss such as that due to normal rod wetting during stroking.

This type of snubber contains a pressurized, external (integral) reservoir.

These pressurized reservoirs are isolated from the atmosphere by a plunger attached to a piston. This type of reservoir is less prone to the intrusion of moisture, but they do have one fault. That is the reservoir plunger penetration does not have a seal and if the snubber is not oriented properly water can penetrate into the atmospheric side of the reservoir and deteriorate the piston and seals causing total fluid loss from the reservoir.

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5.0 HYDRAULIC SNUBBER FLUIDS

5.1 General Requirements

A. The fluid used in snubbers should be fire resistant, radiation resistant, have a flat viscosity curve, and be compatible with seal materials such as ethylene propylene.

B. The silicon fluid used at BFN is General Electric (GE) SF-1154. This fluid is expensive and should be reused when practical. The fluid should not get contaminated since it is used under pressure in these snubbers. Partially used container should be closed with an air tight cap to prevent moisture from entering the container.

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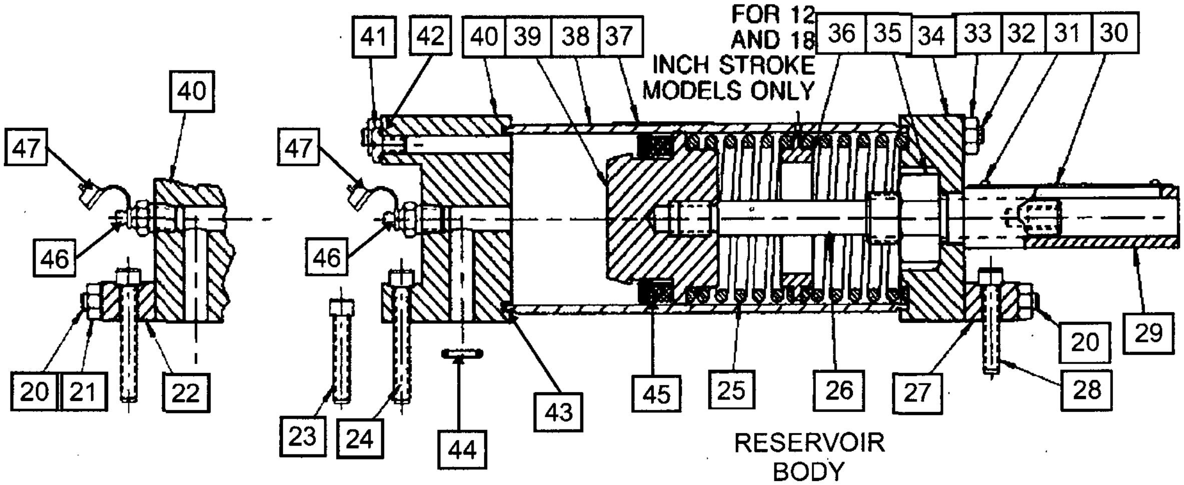
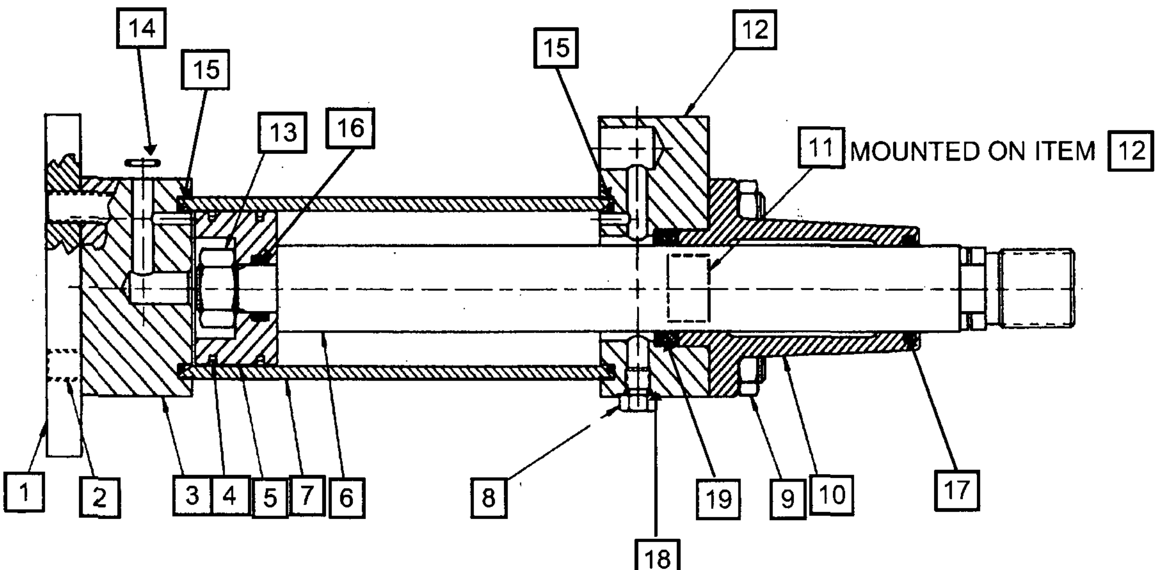
BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS



RESERVOIR BODY



MAIN SNUBBER CYLINDER

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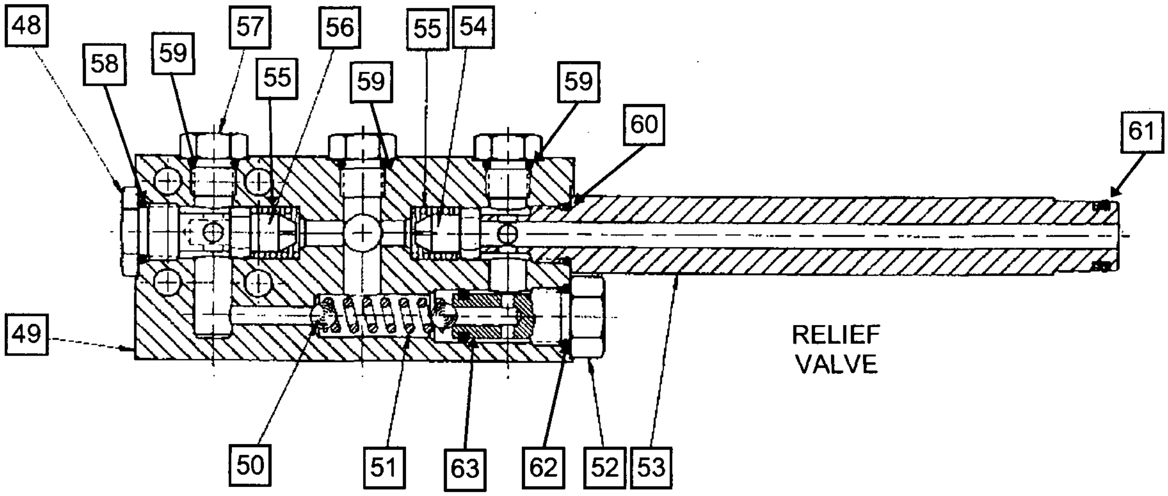
BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS



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BERGEN-PATERSON, ANCHOR/DARLING OR FRONEK HYDRAULIC HARDWARE AND SOFTWARE PARTS LIST

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	MOUNTING FLANGE	33	RESERVOIR TIE ROD NUT
2	TIE ROD	34	RESERVOIR HEAD
3	CAP	35	RESERVOIR INDICATOR TUBE LOCK NUT
4	PISTON RING	36	RESERVOIR SPRING GUIDE
5	PISTON	37	RESERVOIR WARNING TAG
6	CYLINDER TUBE	38	RESERVOIR CYLINDER TUBE
7	PISTON ROD	39	RESERVOIR PISTON
8	FLUSH PLUG-PORT PLUG	40	RESERVOIR CAP
9	TIE ROD NUT	41	RESERVOIR SEAL SCREW
10	GLAND	42	RESERVOIR SEAL SCREW 'O' RING
11	NAME PLATE	43	RESERVOIR CAP OR HEAD TO CYL. 'O' RING
12	HEAD	44	VALVE TO RESERV 'O' RING
13	PISTON ROD NUT	45	RESERV PISTON ROD PACK
14	VALVE TO MAIN BODY 'O' RING	46	RESERVOIR FILLER PLUG
15	CAP OR HEAD TO CYL. 'O' RING	47	RESERV FILL PLUG COVER
16	PISTON TO ROD 'O' RING	48	POPPET STOP AND PLUG
17	MAIN PISTON ROD WIPER	49	FLOW CONTROL BODY
18	FLUSH PLUG-PORT PLUG 'O' RING	50	RELIEF VALVE BALL
19	PISTON ROD PACKING SEAL	51	RELIEF VALVE SPRING
20	RESERVOIR TIE ROD - LONG	52	RELIEF VALVE PLUG
21	RESERVOIR TIE ROD NUT	53	CONNECTOR TUBE
22	RESERVOIR REAR MOUNTING LUG	54	EXTENSION POPPET
23	VALVE BODY MOUNTING SCREW	55	POPPET SPRING
24	RESERVOIR REAR MOUNT SCREW	56	COMPRESSION POPPET
25	RESERVOIR SPRING	57	SAE PORT PLUG
26	RESERVOIR TAIL ROD	58	POPPET STOP & PLUG 'O' RING
27	RESERVOIR FRONT MOUNT LUG	59	SAE PORT PLUG 'O' RING
28	RESERV FRONT MOUNT SCREW	60	CONNECTOR TUBE 'O' RING
29	RESERV INDICATOR PROT TUBE	61	CONN TUBE - HEAD 'O' RING
30	RESERV LEVEL INDICATOR PLATE	62	RELIEF VALVE PLUG 'O' RING
31	NAME PLATE DRIVE SCREW	63	RELIEF VALVE 'O' RING
32	RESERVOIR TIE ROD - SHORT		

APPENDIX C

GRINNELL HYDRAULIC SNUBBER

1.0 GENERAL DESCRIPTION

Hydraulic snubbers consist basically of a main cylinder, main piston, fluid modulating (control valve) device and fluid makeup reservoir. Under normal operating conditions, when piping and equipment moves thermally at relatively low velocities, fluid passes from one end of the main cylinder to the other through control valves with little or no resistance. Under dynamic conditions, at relatively high velocities, the fluid is "choked" (snubber lock up) or blocked at the control valve, allowing little or no further motion of the main piston rod other than that due to compression of the fluid and metallic parts.

BFN purchased its original snubbers from Grinnell Company and they were purchased as Safety-Related, NF. The Grinnell Part Numbering was primarily used which reflects a figure number and the bore size, in inches, of each snubber. These snubbers were manufactured in lots and not given individual serial numbers. Therefore, Browns Ferry developed an individual serial number and stamped this number on the snubber body. This numbering system has been the means of tracking these snubbers as they have been moved from location to location.

There is only one size of Grinnell Hydraulic snubbers at Browns Ferry and this is a 4 inch bore and is listed in the procedures as ITT. There are two different body styles (Lynair and Lindco) of these snubbers. These snubbers are only located in Units 1 and 2.

2.0 The Types and Sizes for the Grinnell Hydraulic snubbers:

GRNL 4, 27.3 Kips, 5 inch stroke (Grinnell part number Fig 200/201)

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2.1 Test Parameters in the Snubber Test Machine Program:

The following parameters shall be verified to work on the test machine, with the associated snubbers, and the accompanying plot shall be located as close to the center of the graph as possible. If the plot does not show in the center of the graph the following parameters may be changed to center the plot and give the best looking plot available.

- **Valve Open** - This value is in percent of command output. If the operator wishes to start the valve sooner the percent value may be reduced, which will require the valve to open sooner causing the command ramp to "jump" up to an initial value and overcome the deadband.

- **Valve End** - The valve end value allows the operator to set an endpoint for the proportional valve opening at less than 100 percent full open. If the operator wishes the profile to extend or reduce this value should be increased or decreased, as necessary. This value must be controlled enough so the snubber will lockup and bleed prior to the end of the test. This value controls the ramp profile in the activation tests.

- **Ramp Duration** - This value sets the time duration of the ramp between valve start and valve end. This value may be decreased, which moves the plot to the left on the graph. In the acceleration tests this value is limited to .45 sec maximum.

- **Load Duration** - This is the time that the valve will remain at the valve end position, after the ramp time has elapsed. Adjusting this value "up" will assure that the complete test will show on the graph.

TYPE	GRNL 4
KIP RATING	27.3
STROKE	5
ACTIVATION RATE	8
RELEASE RATE	4
ACCELERATION RATE	N/A
DRAG FORCE RATE	2
TEST LOAD	80
PRESSURE BOOST	100
VALVE START	5
VALVE END	20
DRAG SPEED	.5
RAMP DURATION	9.5
LOAD DURATION	.4
BENCH (B)IG/ (S)MALL	B

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3.0 LOCKUP/BLEED TYPE CONTROL VALVES

The type control valve used at Browns Ferry in both types of snubbers is a flow sensitive check valve (poppets) in parallel with bleed orifices. The spring is calibrated to keep the poppet valve from closing on its seat until the fluid velocity past the poppet head provides enough force on the poppet to overcome the spring and close the poppet. These are designed as adjustable valves which use screws to make the adjustments. They can be more finely tuned for the lockup and bleed rate desired, but they are also easy to become out of tolerance due to vibration of piping or equipment to which they are attached. When the cylinder has a single ended piston rod and the flow rate from the front and rear of the piston will be different for the same piston velocity, different adjustments are used to force the poppets closed at approximately the same piston velocity in either direction of travel.

These valves have two distinct modes of operation (locked and unlocked). In order for the snubber to return to the free movement mode, after becoming locked, the piston rod velocity must decrease to practically zero. This allows the pressure to drop, the spring to disengage the poppet and the valve assembly to become unlocked.

If for some reason the bleed orifices become clogged the snubber would remain a rigid strut until enough time elapsed to allow the snubber to depressurize. This could cause serious damage to the piping or equipment if thermal movements were required to take place immediately after a dynamic event.

4.0 RESERVOIRS

Hydraulic snubbers usually require a fluid reservoir for the following reasons:

- to provide makeup fluid for the volume displaced by the piston rod in single ended piston rod models.
- to compensate for thermal expansion and contraction of the fluid.
- to provide a fluid reserve in the event of low level fluid loss such as that due to normal rod wetting during stroking.

These snubbers contain non-pressurized (vented), external (integral) reservoirs.

4.0 RESERVOIRS (Continued)

These non-pressurized reservoirs are vented to the atmosphere and should include a breather filter to prevent contaminants from entering. With the silicon fluids being used today there is also a danger of moisture entering the fluid, which may cause rusting, pitting and increased seal degradation to occur. These snubbers should only be installed in an orientation, with the breather port (vent) above the fluid level, to prevent the loss of fluid.

5.0 HYDRAULIC SNUBBER FLUIDS

5.1 General Requirements

A. The fluid used in snubbers should be fire resistant, radiation resistant, have a flat viscosity curve, and be compatible with seal materials such as ethylene propylene.

B. The silicon fluid used at BFN is General Electric (GE) SF-1154. This fluid is expensive and should be reused when practical. The fluid should not get contaminated since it is used under pressure in these snubbers. Partially used container should be closed with an air tight cap to prevent moisture from entering the container.

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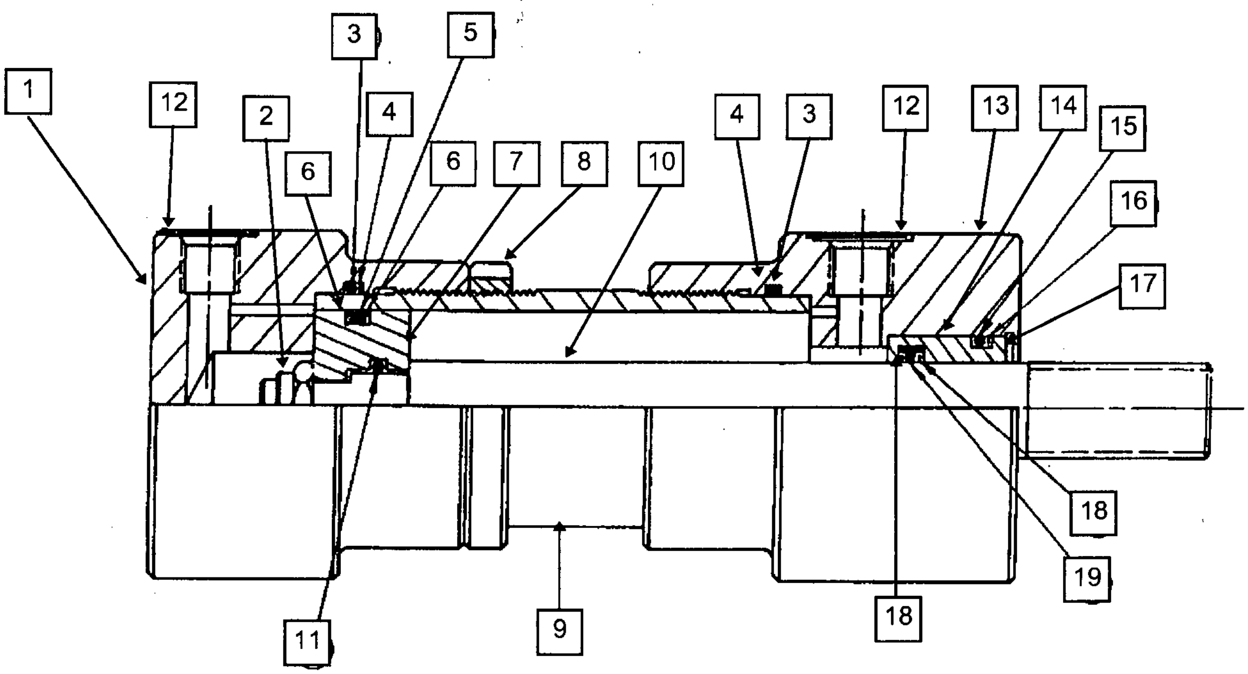
GRINNELL LINDCO HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS



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GRINNELL LINDCO HYDRAULIC HARDWARE AND SOFTWARE PARTS LIST

ITEM NO.	DESCRIPTION
1	REAR HEAD
2	PISTON ROD TO PISTON LOCKNUT
3	HEAD/CAP TO TUBE SEAL 'O' RING
4	HEAD/CAP TO TUBE SEAL BACK-UP RING
5	PISTON T-SEAL
6	PISTON T-SEAL BACK-UP RING
7	MAIN PISTON
8	REAR HEAD TO TUBE LOCK RING
9	MAIN CYLINDER TUBE
10	PISTON ROD
11	PISTON TO PISTON ROD SEAL 'O' RING
12	HEAD/CAP TUBE SEAL 'O' RING
13	FRONT HEAD
14	ROD BEARING
15	ROD BEARING TO HEAD SEAL 'O' RING
16	ROD BEARING TO HEAD SEAL BACK-UP RING
17	SNAP RING
18	ROD T-SEAL
19	ROD T-SEAL BACK-UP RING

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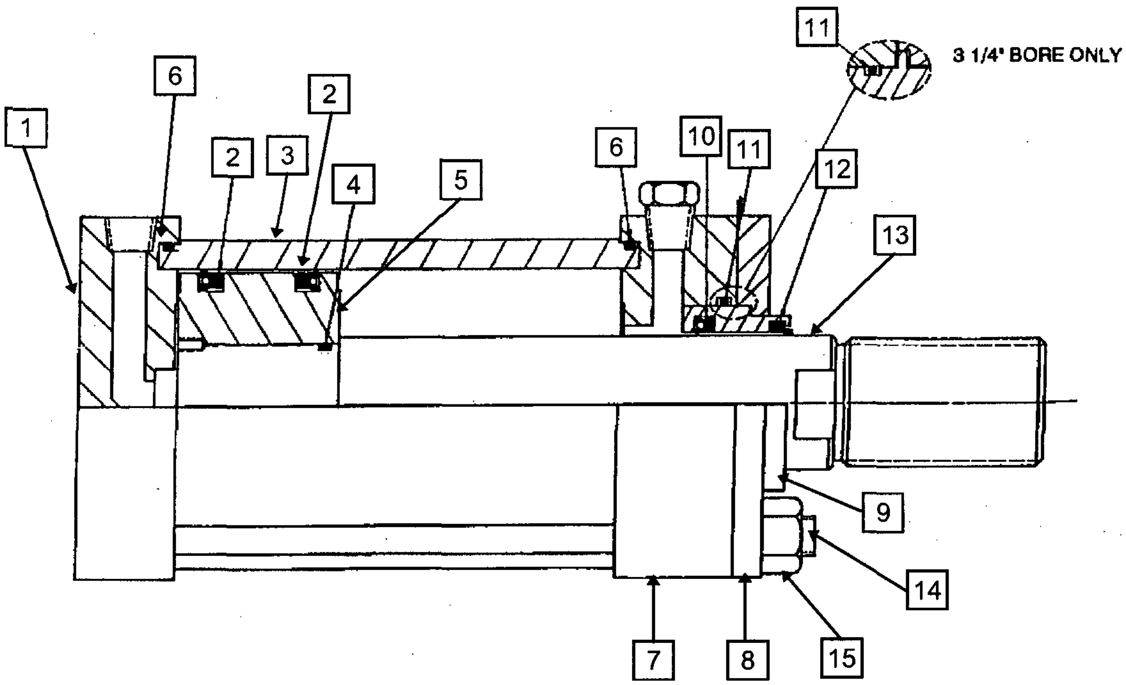
GRINNELL LYNAIR HYDRAULIC HARDWARE AND SOFTWARE PARTS NUMBERS



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GRINNELL LYNAIR HYDRAULIC HARDWARE AND SOFTWARE PARTS LIST

ITEM NO.	DESCRIPTION
1	REAR HEAD
2	POLYPAK PISTON SEAL
3	MAIN CYLINDER SHELL
4	PISTON TO PISTON ROD SEAL 'O'-RING
5	MAIN PISTON
6	SHELL TUBE END SEAL 'O'-RING
7	FRONT HEAD
8	RETAINER PLATE
9	ROD BEARING
10	POLYPAK PISTON ROD SEAL
11	ROD BEARING TO HEAD SEAL 'O'-RING
12	PISTON ROD WIPER
13	PISTON ROD
14	TIE ROD
15	TIE ROD NUT

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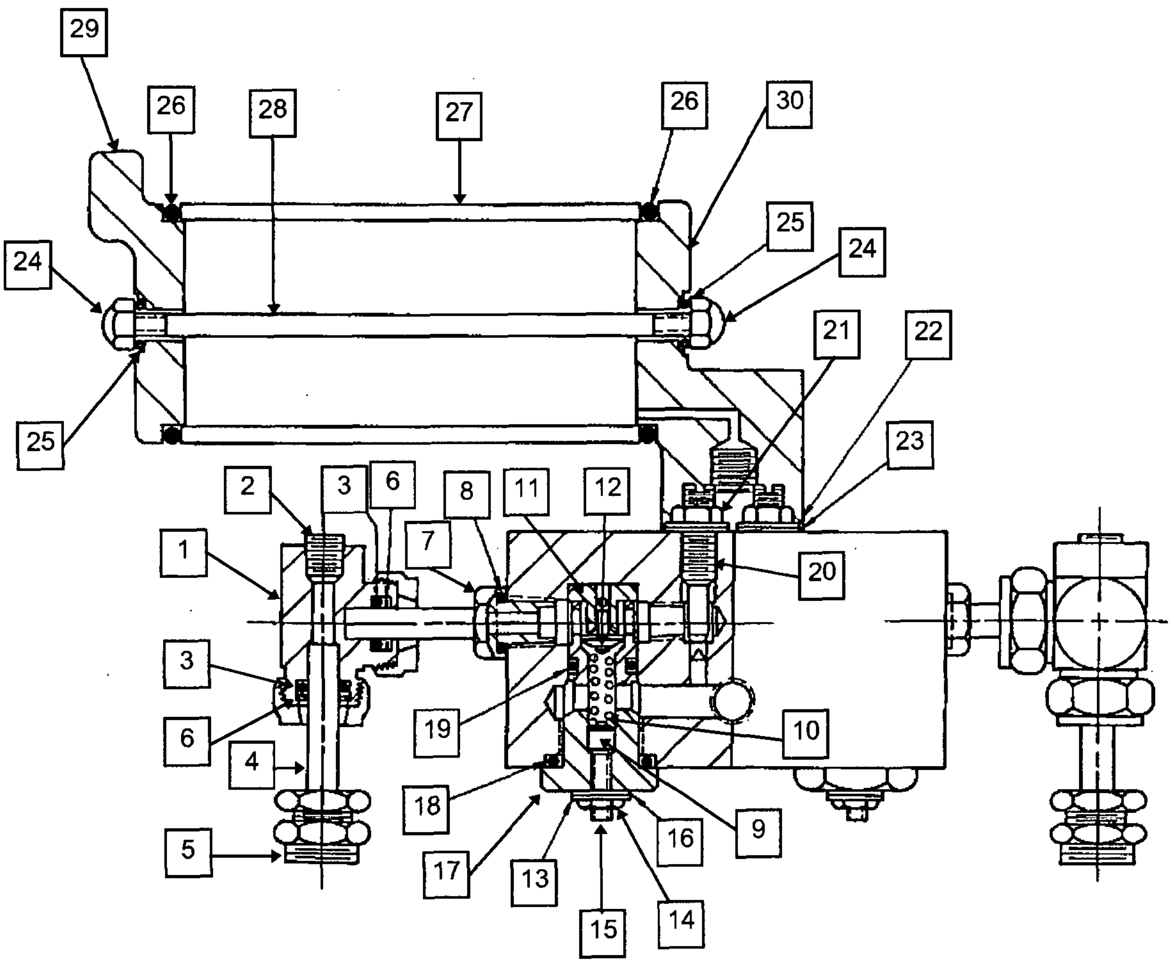
GRINNELL HYDRAULIC DUAL ORIFICE CONTROL VALVE AND RESERVOIR HARDWARE AND SOFTWARE PARTS NUMBERS



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GRINNELL HYDRAULIC DUAL ORIFICE CONTROL VALVE AND RESERVOIR HARDWARE AND SOFTWARE PARTS LIST

ITEM NO.	DESCRIPTION
1	FEMALE RUN LENZ TEE
2	3/8 NPT HEX SOCKET INSERT
3	LENZ TEE SEAL 'O'-RING
4	TUBE PIPE NIPPLE
5	LENZ HEX BUSHING
6	LENZ TEE SEAL BACK-UP RING
7	TUBING CONNECTION
8	CONNECTING TUBE SEAL 'O'-RING
9	SPRING PLUNGER
10	COMPRESSION SPRING
11	STEM GUIDE
12	SEAT
13	LOCK-UP ADJUSTMENT SCREW THREAD SEAL
14	LOCK-UP ADJUSTMENT SCREW LOCK NUT
15	LOCK-UP ADJUSTMENT SCREW
16	LOCK-UP ADJUSTMENT SCREW THREAD SEAL WASHER
17	LOCK-UP BARREL
18	EXTERNAL VALVE BARREL SEAL 'O'-RING
19	INTERNAL VALVE BARREL SEAL 'O'-RING
20	BLEED ADJUSTMENT SCREW
21	BLEED ADJUSTMENT SCREW LOCK NUT
22	BLEED ADJUSTMENT SCREW THREAD SEAL WASHER
23	BLEED ADJUSTMENT SCREW THREAD SEAL
24	CROWN NUT
25	CROWN NUT 'O'-RING
26	RESERVOIR END SEAL
27	RESERVOIR PLEXIGLASS CYLINDER
28	RESERVOIR TIE ROD
29	REAR RESERVOIR HEAD PLATE
30	FRONT RESERVOIR HEAD PLATE

APPENDIX D
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BERGEN-PATERSON TORUS DYNAMIC RESTRAINT HYDRAULIC SNUBBER

1.0 GENERAL DESCRIPTION

There are sixteen Torus Dynamic Restraints installed on each Torus and are located at 22-1/2 degree intervals around the exterior radius of the Torus.

All of the restraints are dimensionally and functionally identical and can be installed at any location.

All of the restraints are identified by individual serial numbers to serve as a specific identification for each restraint during manufacture, initial testing, and future recording purposes.

These restraints effectively restrain forces in both tension and compression, along an axis of 45 degrees from the horizontal, in the radial direction from the centerline of the reactor.

The restraints have a service life of 40 years and no service life monitoring program will be required for these restraints.

The Torus Dynamic Restraints consist of a 12 inch bore, internally ported hydraulic, cylinder having a poppet valve assembly located in recesses machined in the blind and rod end heads.

The valve controlling movement in the extension direction is located in the rod end head (nearest the Torus) and the valve controlling movement in the retraction direction is located in the blind end head (nearest the wall).

The poppet valve has grooves which allow a small amount of fluid to pass the poppet after the activation velocity, of between 6 and 25 inches per minute, has been exceeded and the poppet has closed.

A spring loaded pressurized fluid accumulator is mounted on flat machined surfaces on the upper portion of the circular surface of the blind end and rod end heads. The hydraulic system is maintained under pressure to maintain a minimum required 6300 kips/in spring constant.

The restraint has a total stroke length of 1-1/2 inches.

The rod end paddle of the restraint is pinned to a clevis bracket welded to each ring girder above the PSC ring header support.

The blind end paddle is pinned to a clevis bracket mounted on the wall.

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1.0 GENERAL DESCRIPTION (Continued)

The original pins are 4 inch diameter and have a slight interference fit between the clevis eye and the spherical bushing on the restraint.

When the restraints are removed for functional testing, a new two piece pin installed in the place of the shrink fit pin to enhance the removal and reinstallation of the restraints in the future.

All of the Bergen-Paterson Torus Dynamic Restraints are accessible during reactor operation and form a single group because they are identical in design. They are a group separate from other Bergen-Paterson snubbers because of the seal, valve design and size.

The restraints are designed to reduce the dynamic response of the Torus to excitation caused by a design base LOCA.

The principal specification governing performance of the restraints is the 7000 kip/inch minimum dynamic spring rate.

The restraints have a maximum rated load of 200 KIPS in tension and 230 KIPS in compression.

2.0 OPERABILITY REQUIREMENTS AND MAINTENANCE RECOMMENDATIONS (CEB '84 0503 015)

2.1 This information defines operability requirements for the Bergen-Paterson Torus Dynamic Restraint Snubbers and provides related maintenance recommendations.

2.2 General Operability Requirements

Torus Restraint Snubber (TRS) operability is of concern for conditions requiring primary containment integrity and for which a significant potential for a Loss of Coolant Accident (LOCA) exists. Those conditions exist when the reactor is in the operating, hot standby, or hot shutdown mode, as defined by the BFN Technical Specifications. They do not exist in the refueling or cold shutdown mode.

To be considered operable, a TRS must be installed and maintained in accordance with all applicable TVA design drawings and BP instruction manuals. In addition, the snubber reservoir fluid level must be maintained such that an acceptable axial spring rate is provided.

2.3 Effect of Inoperability

The TRS function is to reduce dynamic motion of a Torus and its attachments (structures and piping) during postulated LOCA events. They also limit Torus motion during normal safety/relief valve discharges and postulated seismic events but are not required for plant safety under those conditions.

Each TRS restrains 1 of the 16 ring girders on a Torus. Its region of significant influence is within the two Torus bays adjacent to that ring girder. Each TRS basically functions independently during a postulated LOCA event.

If one TRS was inoperable during a LOCA, the applicable code allowable stress for the Torus and attachments in the adjacent bays could be exceeded. If two or more snubbers were inoperable, proportionately larger regions of the Torus would be similarly affected. Maximum dynamic response would occur in a Torus bay if the snubbers for both adjacent ring girders were inoperable. Under such conditions, the affected Torus and attachment regions would be substantially degraded, relative to satisfying code allowable stresses, but still capable of withstanding the most probable design basis accident, intermediate break accident, and small break accident LOCA loads without loss of containment integrity.

2.4 Recommended Fluid Level Limits for Disk Spring Reservoirs

1. Applicability

   These limits are applicable during operating cycle 6 and later cycles of each unit when the reactor is in the operating, hot standby, or hot shutdown mode.

2. Limits (both must be satisfied)

   a. Maximum $d = 1.595 - 0.01483 (100 - T)$

   b. Minimum $d = 0.904 + 0.01561 (T - L)$

   Where:

   d = Distance from end of indicator rod to face of reservoir at temperature T (inches).

   T = Snubber temperature when d is measured (° F).

   L = Minimum snubber temperature for the time period of concern (° F).

2.4 Recommended Fluid Level Limits for Disc Spring Reservoirs (Continued)

Notes:
1. The reservoir is full when d = 3.118 inches and it is 1/5 full when D = 0.904 inch.
2. L may be conservatively set at 50 ° F. Less conservative values of L are also permissible if justified by in-plant temperature data. L may not be greater than T.
3. No maximum d limit is defined in consideration of the over pressure relief feature of the disc spring reservoirs.

3. Basis for limits

These limits ensure a minimum spring rate of 6300 kips per inch for all anticipated snubber temperatures, including an upper limit of 100 ° F. They are based upon approved BP test and design documentation for the TRS assemblies. An EN DES calculation CD-Q0010-890191 (CEB 840330 012) documents their deviation.

2.5 Recommended TRS Maintenance Policies for each BFN Unit

1. Operability of a leaking TRS

A leaking TRS shall be declared inoperable if reservoir filling to maintain acceptable fluid levels is required at time intervals of 3 hours or less.

A leaking TRS may be electively declared inoperable if another TRS or the drywell/wetwell differential pressure system is not already inoperable.

The 3 hour time limit is based upon a 20 minute LOCA dynamic load duration with no reservoir filling during the event. Note that a TRS will not become inoperable due to air ingestion during operation as long as the fluid reservoir remains pressurized to levels ensured by the specified level limits. The restrictions on electively declaring inoperability are based upon minimizing the probability for maximum Torus response during postulated LOCA events.

2. Exceeding Fluid Reservoir Limits

If a TRS reservoir fluid level is found outside the limits specified in this section at snubber temperature T and with L = T, the TRS shall be declared inoperable until the fluid level is restored to an acceptable value.

2.5 Recommended TRS Maintenance Policies for each BFN Unit (Continued)

3. Exceeding Temperature Limits

   If a TRS temperature is found outside the range from 50° F to 100° F, Site Engineering (Civil) shall be notified and an operability determination shall be made within 72 hours.

   This position is based upon the anticipated normal range of TRS fluid temperatures and the TRS design temperature range. Torus room ambient air temperatures outside this range would indicate a very unusual occurrence. Note that insignificant increases in TRS fluid temperatures are predicted during LOCA dynamic events.

4. Engineering Evaluations

   An engineering evaluation shall be performed for each instance in which a TRS is determined to be inoperable. Site Engineering (Civil) shall provide assistance upon request and shall be informed of the evaluation results.

5. Functionality Testing

   Functionality tests are not necessary on a routine basis or as a result of anticipated cases of TRS inoperability. It is possible, but not probable, that limited functionality tests may be required for extreme cases of inoperability. That determination must be made by the required engineering evaluations on a case-by case basis.

   This position is based upon the extensive qualification tests and functionality tests performed by BP. It is also based upon performing installation and maintenance in strict compliance with approved procedures.

2.6 References Concerning Operability of the Torus Restraint Snubbers

1. H. J. Green's Memorandum to M. N. Sprouse dated March 15,1983 (DES 830316 019)
2. M. N. Sprouse's Memorandum to H. J. Green dated April 4, 1983 (MEB 830404 006)
3. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Gil Payne) dated March 29, 1983 (MEB 830330 526)
4. G. L. Payne Note to R. O. Barnett dated April 1, 1984 (MEB 830401 028)
5. R. O. Barnett Memorandum to G. R. Hall dated April 12, 1984 (CEB 830412 015)
6. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated July 25, 1983 (MEB 830728 503)
7. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated September 7, 1983 (MEB 830909 525)
8. R. O. Barnett Note to J. K. Rochelle dated September 12 1984 (MEB 830912 021)
9. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. C. A. Chandley) dated March 7, 1984 (MEB 840313 502)
10. R. O. Barnett Note to J. K. Rochelle dated March 15,1984 (MEB 840316 010)
11. E. H. New Memorandum to C. A. Chandley dated January 12, 1984 (MEB 840116 507)
12. C. A. Chandley Memorandum to E. H. New dated February 8, 1984 (MEB 840208 019)
13. E. H. New Memorandum to C. A. Chandley dated February 27, 1984 (LOO 840228 191)
14. C. A. Chandley Memorandum to E. H. New dated March 12, 1984 (MEB 840312 016)
15. G. T. Jones Memorandum to P. R. Wallace dated March 13, 1984 (L52 840313 809)
16. J. A. Coffey's Memorandum to R. W. Cantrell dated March 21, 1984 (L22 840321 800)
17. Calculation for Fluid Level Limits for Torus Restraint Snubbers (CEB 840330 012)
18. W. S. Wilburn's Memorandum to G. T. Jones dated April 6, 1984 (L22 840406 801)
19. R. W. Cantrell's Memorandum to J. A. Coffey dated April 11, 1984 (MEB 840411 009)
20. R. W. Cantrell's Memorandum to J. A. Coffey dated May 3, 1984 (CEB 840503 015)

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2.6 References Concerning Operability of the Torus Restraint Snubbers (Continued)

21. J. P. Darling Memorandum to R. W. Cantrell dated May 4, 1984 (L22 840504 800)
22. Gil Payne's Memorandum to Mechanical Engineering Support Branch Files dated May 31, 1984 (MEB 840531 008)
23. J. P. Darling's Memorandum to R. W. Cantrell dated June 21, 1984 (L22 840618 800)
24. Bergen-Paterson Pipesupport Corp. Memorandum to TVA (Mr. H. E. Crisler) dated May 8, 1986 (B22 860512 001)
25. H. B. Bounds' Memorandum to G.G. Campbell dated November 25, 1988 (B22 881123 305)
26. D. C. Mims' Memorandum to J. W. Hutton dated July 25, 1989 (R20 890725 999)
27. Torus Integrity Long - Term Program, Plant Unique Analysis Report (CEB 841210 008)
28. Technical Operability Evaluation 2-96-064-0834 (R40 960715 950)
29. Engineering Work Request 98-3-064-071 (R21 980921 003)
30. Technical Operability Evaluation 2-99-064-11704 dated October 18, 1999

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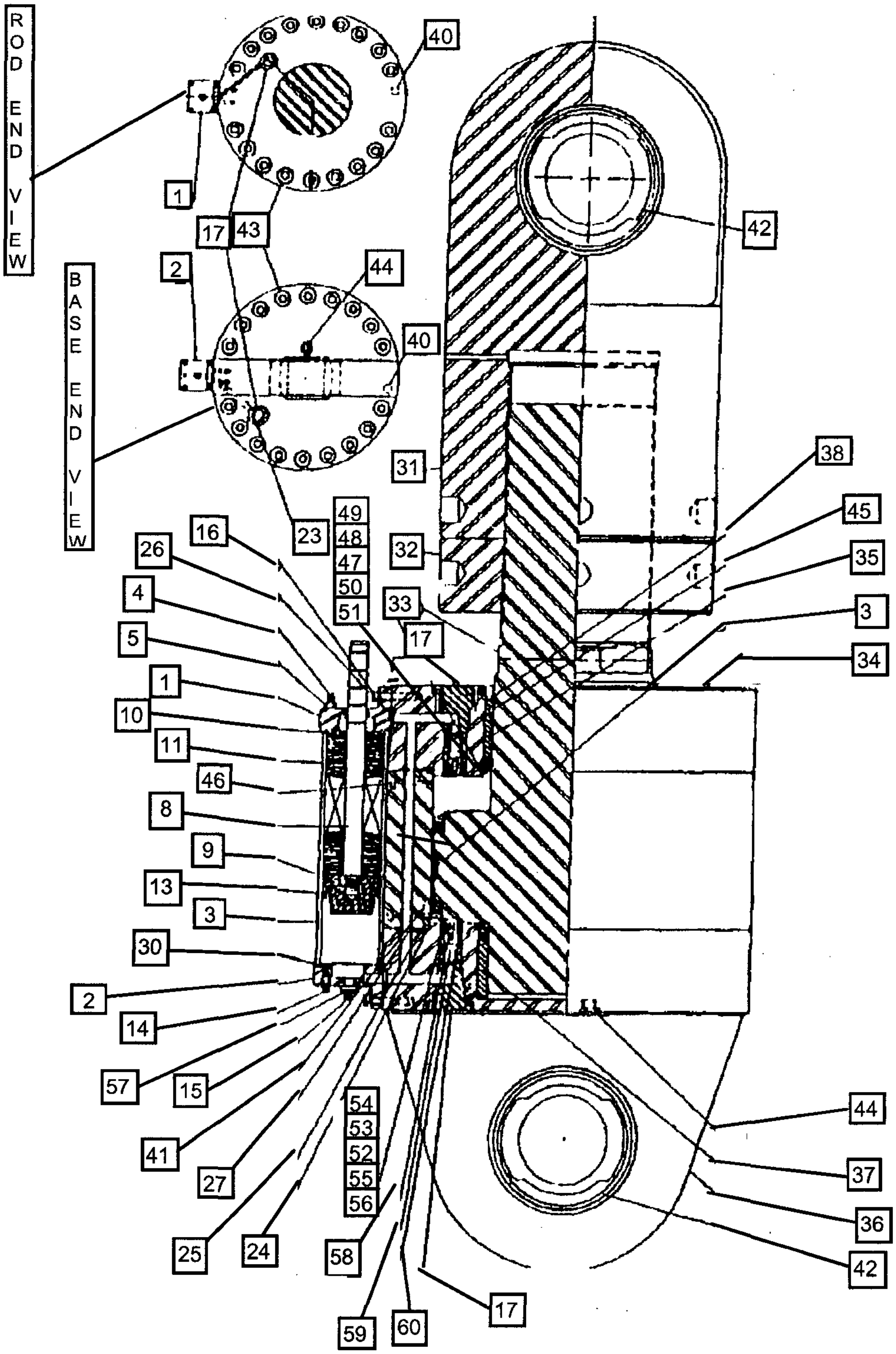
BERGEN-PATERSON
TORUS DYNAMIC RESTRAINT SNUBBER



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BERGEN-PATERSON TORUS RESTRAINT SNUBBER PARTS

ITEM NO	DESCRIPTION	ITEM NO	DESCRIPTION
1	RESERVOIR HEAD	31	ROD EYE
2	RESERVOIR CAP	32	LOCK NUT
3	RESERVOIR TUBE	33	MAIN PISTON ROD
4	TIE RODS	34	MAIN CYL. ROD HEAD
5	TIE ROD NUTS	35	ROD HEAD GLAND BUSHING
6		36	MAIN CYL. BASE HEAD
7		37	BASE HEAD GLAND BUSHING
8	INDICATOR ROD	38	ROD HEAD BUSHING RET. RING
9	RESERVOIR PISTON	39	MAIN PISTON RIDER
10	RESERVOIR SPRING SPACER	40	LOCATOR PIN
11	BELLEVILLE SPRING	41	MAIN CYL. BARREL TUBE
12		42	BALL BUSHINGS
13	RESERVOIR PISTON PACKING	43	CAP SCREWS
14	RESERVOIR BLEEDER	44	BASE HEAD BREATHER
15	FILLER FITTING	45	ROD WIPER
16	CAP SCREWS	46	TUBE BLEEDERS
17	VALVE BLOCK	47	ROD SEAL ENERGIZERS
18		48	ROD SEAL V - PACKING
19		49	ROD SEAL BACK - UP RING
20		50	ROD SEAL WAVE SPRING
21		51	ROS SEAL RETAINING RING
22		52	PISTON SEAL ENERGIZERS
23	CAP SCREWS	53	PISTON SEAL V - PACKING
24	CYL. TUBE/HEAD INNER RING	54	PISTON SEAL BACK - UP RING
25	CYL. TUBE/HEAD OUTER RING	55	PISTON SEAL WAVE SPRING
26	RESERVOIR TO HEAD	56	PISTON SEAL RETAINING RING
27	HEAD TO TUBE MANIFOLD	57	ALUMINUM SPACER RING
28		58	POPPET STOP
29		59	POPPET
30	RESERVOIR SEAL	60	POPPET SPRING

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LISEGA TORUS DYNAMIC RESTRAINT HYDRAULIC SNUBBER

1.0 GENERAL DESCRIPTION

The mode of operation of these hydraulic shock absorber rests on the fact that, except for a minimal friction, no resistance is offered to a slow movement of the connected components.

Under undesirable, shock-type movements resulting from unplanned load conditions the shock absorber locks and forms momentarily an almost rigid connection. The dynamic forces occurring as a result are absorbed and conducted harmlessly into the structural connection. At the reduction of the pressure wave to almost 0, the locking terminates and a possible simultaneous temperature movement is no longer inhibited.

During reversal of direction of movement caused by counter-oscillation or renewed impulse, the mode of operation takes place in the reverse direction. It can change infinitely within the frame of complex oscillation spectrums. The response reaction of these shock absorbers lies in a frequency band of 0.5-100 Hz.

During slow movement of the piston ($\leq$ 4.72 in/min.), spring pressure keeps the valve open, allowing the hydraulic fluid to flow from one side of the piston to the other.

During fast movement of the piston ($\geq$ 4.72 in/min. approx.), fluid flow pressure on the valve plate closes the main valve. The flow of hydraulic fluid is stopped and the movement of the piston is restricted. The compressibility of the fluid has a softening effect on the restriction of the piston. As fluid is compressed by the piston, the movement is arrested elastically. As a result, damaging load spikes are avoided.

As the load subsides, the pressure on the closed valve is reduced. When the force of the spring is greater than the compression force of the fluid, the valve opens.

To eliminate any possibility of the valve remaining closed, it is fitted with a by-pass bleed system. This allows a very limited movement of the piston under load, and ensures quick equalization of pressure between the cylinder chambers when the load is removed.

1.0 GENERAL DESCRIPTION (Continued)

The position of the main piston within the cylinder can be instantly read by checking the concentric scale rings machined into the piston rod. The sturdy stainless steel shroud protecting the piston rod also duals as a position indicator.

In order to maintain the functional performance of the snubber, sufficient hydraulic fluid must be maintained within the unit. The reservoir has a rod attached to the reservoir piston that protrudes from the reservoir. Markings to indicate the fluid level in the unit are scribed onto the rod. Inspection of this indicator eliminates the necessity for dismantling the snubber cylinder to determine the fluid level.

2.0 CONTROL VALVES

The control valves are placed in the body of the shock absorber on opposite ends of the cylinder. They are aligned to the reservoir, and work directly with the volume compensator.

In order to facilitate scheduled maintenance, the control valves can be removed while the snubber remains in place. Previously qualified and tested valves can be installed immediately and the snubber returned to service. The original valves can then be remotely tested using a surrogate snubber on a standard snubber test bench.

3.0 RESERVOIR

In order to accommodate increased fluid volume compensation requirements, the reservoir cylinder is positioned parallel to the working cylinder to avoid disproportionate dimension and weights. The reservoir is sealed against the atmosphere by a spring-loaded piston. While sealing the reservoir, the piston also generates a small amount of pressure within the system. This positive pressure energizes the seals in the snubber, increases their effectiveness and prevents ingestion of air.

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4.0 HYDRAULIC SNUBBER FLUIDS

4.1 General Requirements

The fluid in the snubbers should be fire resistant, radiation resistant, have a flat viscosity curve, and be compatible with seal materials such as Viton.

The silicon fluid used at BFN for these snubbers is Silicone AP 280 furnished by LISEGA. This fluid is expensive and should be reused when practical. The fluid should not get contaminated since it is used under pressure in these snubbers. Partially used containers should be closed with air tight cap to prevent moisture from entering the container.

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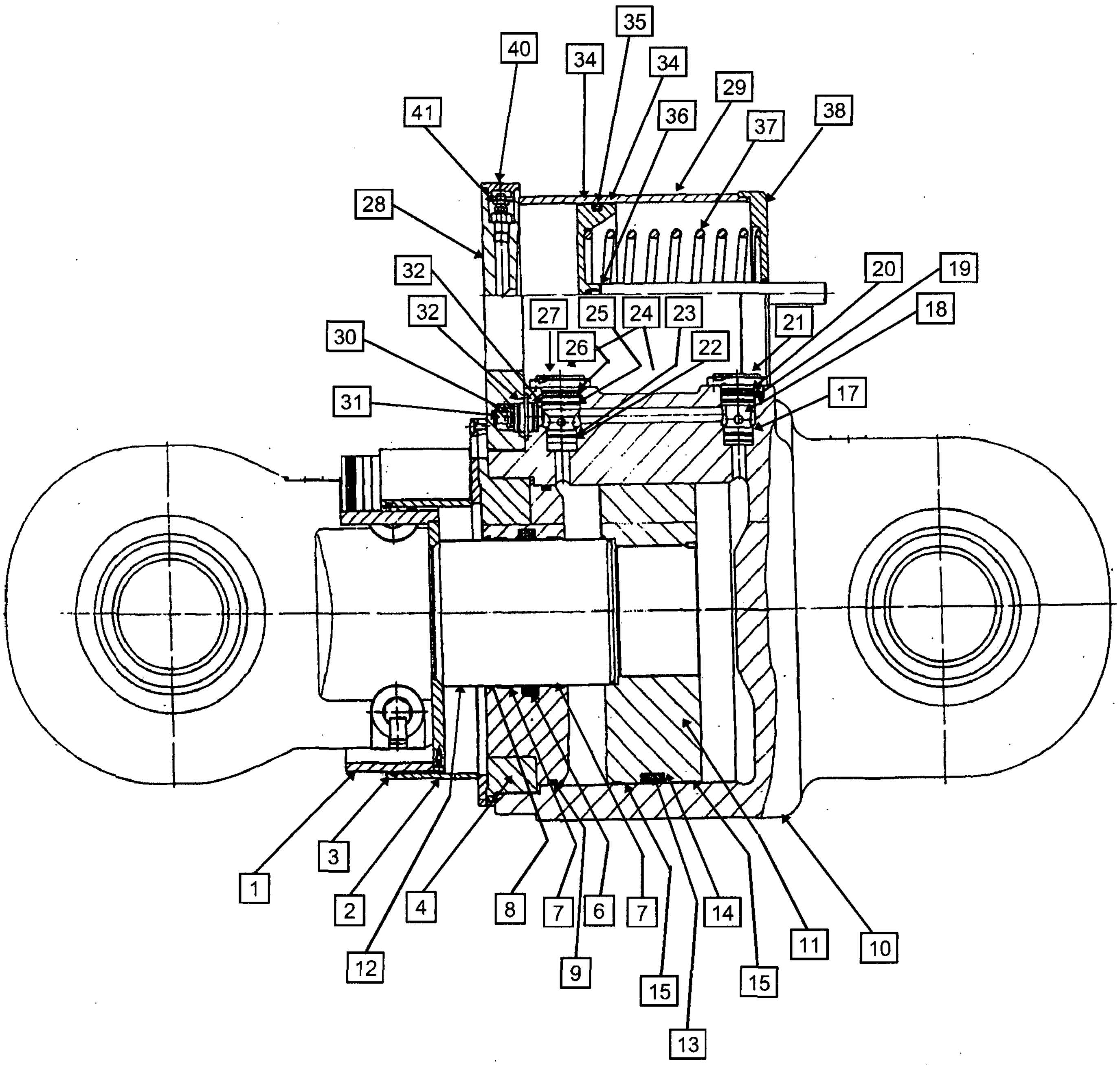
LISEGA TORUS
DYNAMIC RESTRAINT SNUBBER



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LISEGA TORUS DYNAMIC RESTRAINT SNUBBER PARTS

ITEM NO.	DESCRIPTION	ITEM NO.	DESCRIPTION
1	TRAVEL INDICATOR TUBE	22	FRONT VALVE SEAT CIRCLIP
2	PROTECTIVE TUBE	23	FRONT LOWER VALVE “O”RING
3	PROTECTIVE TUBE WIPER RING	24	FRONT VALVE
4	THREADED RING (Upper Cylinder)	25	FRONT UPPER VALVE “O”RING
5	CYLINDER BODY LID (Upper Cylinder)	26	FRONT VALVE LID “O”RING
6	COMPLETE ROD SEALING SET	27	FRONT VALVE LID
7	GUIDE BAND	28	RESERVOIR BOTTOM
8	PISTON ROD COMPACT SEAL	29	RESERVOIR TUBE
9	CYLINDER DOUBLE WHIPER RING	30	CLOSING PISTON
10	MAIN CYLINDER BODY	31	CLOSING PISTON SPRING
11	MAIN CYLINDER PISTON	32	CLOSING PISTON “O”RING
12	MAIN CYLINDER PISTON ROD	33	RESERVOIR PISTON
13	PISTON “O”RING	34	RESERVOIR PISTON GUIDE BAND
14	PISTON SEAL SET	35	RESERVOIR PISTON V-PACKING RING
15	GUIDE BAND	36	RESERVOIR PISTON ROD CIRCLIP
16	REAR VALVE SEAT CIRCLIP	37	RESERVOIR SPRING
17	REAR LOWER VALVE “O”RING	38	RESERVOIR LID
18	REAR VALVE	39	RESERVOIR FLUID INDICATOR ROD
19	REAR UPPER VALVE “O”RING	40	RESERVOIR FLUID FILL CAP
20	REAR VALVE LID “O”RING	41	RESERVOIR DEAERATING VALVE
21	REAR VALVE LID		

APPENDIX F
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PACIFIC SCIENTIFIC COMPANY (PSA)
MECHANICAL SNUBBER

1.0 DESCRIPTION, DESIGN AND OPERATION OF MECHANICAL SNUBBERS

1.1 General Description

Mechanical snubbers are manufactured by Pacific Scientific Company and are designated as PSA. Mechanical snubbers have dual failure modes in that they may either fail to activate or may "freeze" or lockup, becoming a rigid restraint.

The PSA snubber is acceleration limiting, and is effective in a seismic event because the motion is cyclic in a frequency range of 3 to 33 Hertz. PSA snubbers operate on the principle of limiting acceleration values of any pipe movement to a threshold level of 0.02 g's (7.7 in/sec squared). This is the maximum acceleration that the snubber will permit, and a breaking force will be applied within the snubber of whatever magnitude is required to limit the acceleration to a value less than 0.02 g's. At the same time, thermal expansion, being a gradual movement, is not restricted. A particular feature of mechanical snubbers is that at no time does it lock and become a rigid strut. When sudden acceleration occurs and is sustained continuously in one direction, the snubber will apply necessary force to limit the pipe movement to its preset threshold value. The snubber's performance is independent of the amount of force being applied (provided the force is less than the rated load).

BFN purchased all of its PSA snubbers through Bergen-Paterson, therefore, the Bergen-Paterson Part Numbering was primarily used which reflects the rating in KIPS of each snubber. Additionally, a majority of the PSA snubbers were purchased Safety-Related, NF. The PSA Part Numbers differ from the Bergen-Paterson because the snubbers were originally qualified Pre-NF, and given Part Numbers in accordance with that KIP rating. When the same components were re-qualified under NF, their KIP ratings increased but PSA never changed Part Numbers. Only a few PSA-10 snubbers were purchased as Pre-NF. These snubbers are located in all three units and are painted white to distinguish them from the NF snubbers. The Pre-NF snubbers are rated at 10 Kips while the NF snubbers are rated at 15 Kips. They are located on the Main Steam Relief Valve (MSRV) Tail Pipes. When the Pre-NF, 10 Kip, snubbers are replaced in Units 2 or 3, the replacement snubbers will be removed from Unit 1 until the usable supply of these snubbers has been depleted.

1.2 Pacific Scientific Mechanical Snubber (PSA-1/4 AND PSA-1/2) Design and Operation

Following is a description of the design and method of operation of the three versions of the PSA snubbers. Some details of the internal mechanism are different, depending on the capacity of the snubber, but the principle of operation is the same.

Figure 1 shows a cross section representing PSA-1/4 and PSA-1/2 snubbers. Also, Figure 2 shows the part numbers of the snubbers.

The snubber consists essentially of an inertia mass containing a clutch spring, a torque carrier and screw shaft assembly which also contains a capstan spring, a rod and bearing assembly, an inner tube, an anti-rotation key, a housing and a telescoping outer tube.

The rod and bearing assembly consists of a spherical bearing, end plug, two connecting rods and a helical cam bearing. The helical cam bearing end of the rod and bearing assembly engages the screw shaft of the torque carrier and shaft assembly. The shaft mounts the inertia mass, inside which is installed the clutch spring. The tangs of the capstan spring installed in the torque carrier are positioned between the lips of the clutch spring installed in the inertia mass. In this manner, the torque carrier is coupled to the inertia mass. The housing is secured by a retaining ring to the flange on the end of the inner tube. The housing shields the internal parts of the arrestor and prevents contaminants from entering,

The restricting function of the snubber is primarily accomplished by changing the relative linear motion, of the telescoping inner and outer tubes of the snubber, into rotary motion of the torque carrier and the inertia mass. Figure 1 shows the snubber almost fully retracted. As the snubber is extended, the outer cylinder attached to the spherical bearing end, slides over the inner cylinder which is attached to the housing. The nut is attached to the spherical bearing end by the two rods. As the nut moves with the spherical bearing and, it forces the shaft screw to turn which makes the torque carrier spin, since they have a press fit.

The capstan spring rotates with the torque carrier, and the tangs of the capstan spring also drive the inertia mass through engagement with the up-turned ends of the clutch spring. If the speed of the torque carrier is changed, the speed of the inertia mass must also change since they are connected by the tangs of the capstan spring.

1.2 Pacific Scientific Mechanical Snubber (PSA-1/4 AND PSA-1/2) Design and Operation (Continued)

If the speed change is made suddenly, the inertia mass, by tending to stay at its existing speed, will overcome the capstan spring resistance and close it down on the end of the inner cylinder which is stationary in the housing. The spring in contact with the inner cylinder acts as a brake and slows the change in speed of the torque carrier as it is driven by the nut moving, as the snubber is extended. The same type of action takes place as the snubber is retracted. By this action the snubber limits the rate of velocity change or acceleration.

Vibrations cause rapid changes in direction and velocity which activate the snubber by causing the capstan spring to close down on the end of the inner cylinder.

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FIGURE 1
PSA-1/4 AND PSA-1/2
CROSSECTION

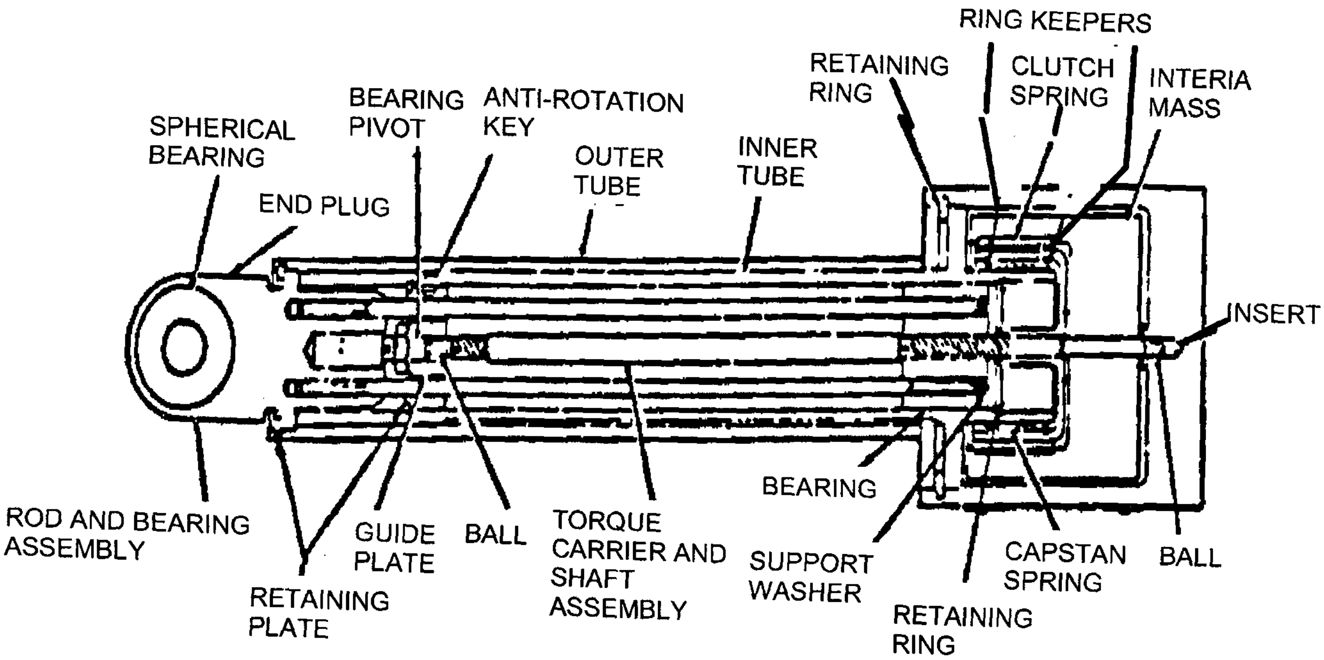

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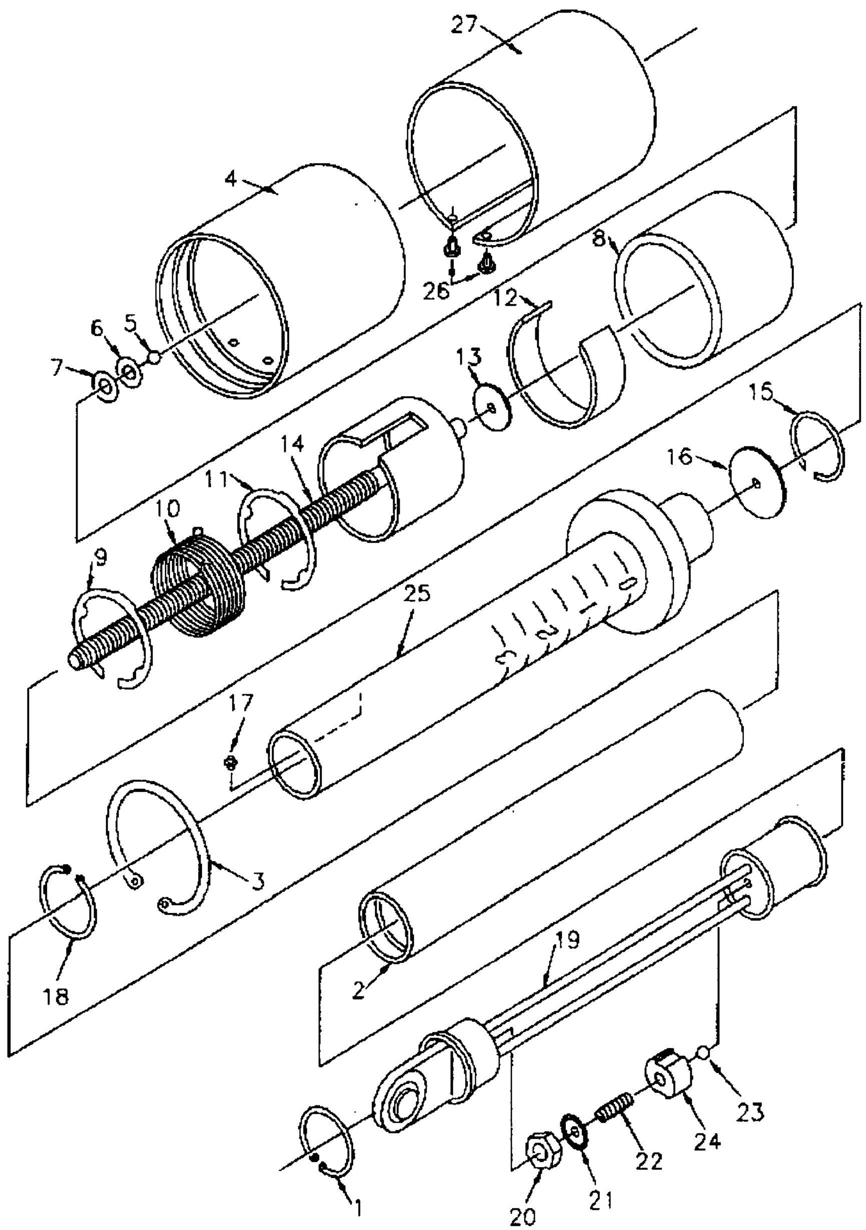
FIGURE 2
PSA-1/4 AND PSA-1/2 PARTS



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PSA-1/4 AND PSA-1/2 PARTS LIST

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801104-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1/4	A
	1801104-07	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1/2	B
1	0911100-89	RING, RETAINING	A,B
2	1801247-01	TUBE, OUTER	A
	1801247-03	TUBE, OUTER	B
3	0911100-90	RING, RETAINING	A,B
4	1801900-01	HOUSING AND INSERT ASSEMBLY	A,B
5	1801367-01	BALL	A,B
6	0903100-36	WASHER	A,B
7	0903100-37	WASHER	A,B
8	1801241-01	INTERIA MASS	A,B
9	1801537-01	RING, KEEPER	A,B
10	1801612-01	SPRING, CAPSTAN	A,B
11	1801537-01	RING, KEEPER	A,B
12	1801305-01	SPRING, CLUTCH	A,B
13	0903100-50	WASHER, FLAT	A,B
14	1801861-01	CARRIER AND SHAFT ASSEMBLY, TORQUE	A
	1801862-01	CARRIER AND SHAFT ASSEMBLY, TORQUE	B
15	0911100-91	RING, RETAINER	A,B
16	1801306-01	WASHER, SUPPORT	A,B
17	1801303-01	KEY, ANTI-ROTATION	A,B
18	0911100-08	RING, RETAINING	A,B
19	1801533-01	ROD AND BEARING ASSEMBLY	A
	1801533-03	ROD AND BEARING ASSEMBLY	B
20	NAS671-8	NUT, JAMB	A,B
21	MS35335-31	WASHER, LOCK	A,B
22	1801311-01	BEARING, PIVOT	A,B
23	1801367-01	BALL	A,B
24	1801252-01	GUIDE PLATE	A,B
25	1801250-01	TUBE, INNER	A
	1801250-03	TUBE, INNER	B
26	AN535-2-2	SCREW, DRIVE	A,B
27	1801301-01	NAMEPLATE	A,B

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1.3 Pacific Scientific Mechanical Snubber (PSA-1, PSA-3 AND PSA-10) Design and Operation

Figure 3 is a cross section that represents the PSA-1, PSA-3, and PSA-10 snubbers. Also, Figure 4 shows the part numbers of the snubbers.

The snubbers consists of a support cylinder, an inertia mass containing a clutch spring, a torque transfer drum containing a capstan spring, an end plug assembly, a position indicator tube, and a housing. The support cylinder contains a telescoping cylinder, and anti-rotation key, and a ball bearing screw assembly. The telescoping cylinder and recirculating ball nut and screw assembly are the main design concept difference from the PSA-1/4 and PSA-1/2.

The ball screw is supported by the traveling recirculating ball nut and by a ball bearing assembly near one end. The recirculating ball nut is staked to and travels with the telescoping cylinder, as do the end plug assembly and the position indicator tube. The ball screw shaft extends through the thrust bearing fitted into the bore of the support cylinder. The ball screw shaft mounts through the torque drum and inertia mass and is keyed to the torque drum and the inner race of the thrust bearing. The inertia mass is free to rotate on the end of the ball screw shaft. The tangs of the capstan spring installed in the torque drum extend through a slot in the torque drum and are located between the up-turned ends of the clutch spring installed in the inertia mass. This couples the torque drum to the inertia mass. The housing is attached by a retaining ring to a flange at the capstan end of the support cylinder. The housing and a dust cover shield the internal parts of the arrestor and prevent contaminants from entering. The restraining function of the PSA-1, -3, and -10 snubbers is accomplished by translating linear motion of the telescoping cylinder, within the support cylinder, into rotary motion of the torque drum and the inertia mass. As the snubber is extended or retracted, the telescoping cylinder moves inside the support cylinder. The recirculating ball nut is fixed to the telescoping cylinder, and the telescoping cylinder is prevented from rotating by the anti-rotation key attached to the stationary support cylinder. Therefore, as the recirculating ball nut is moved in or out with the telescoping cylinder, the ball screw is forced to rotate, and the torque drum spins with it. The tangs of the capstan spring drive the inertia mass, and if the speed is changed gradually, the spring does not tighten down on the end of the support cylinder. If the speed changes suddenly, either slowing down or increasing, the inertia mass displaces the tangs of the capstan spring and closes the spring down on the end of the support cylinder, acting as a brake. The arresting action of the snubber is essentially the same as for the PSA-1/4 and PSA-1/2.

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FIGURE 3
PSA-1, PSA-3 AND PSA-10
CROSSECTIOI

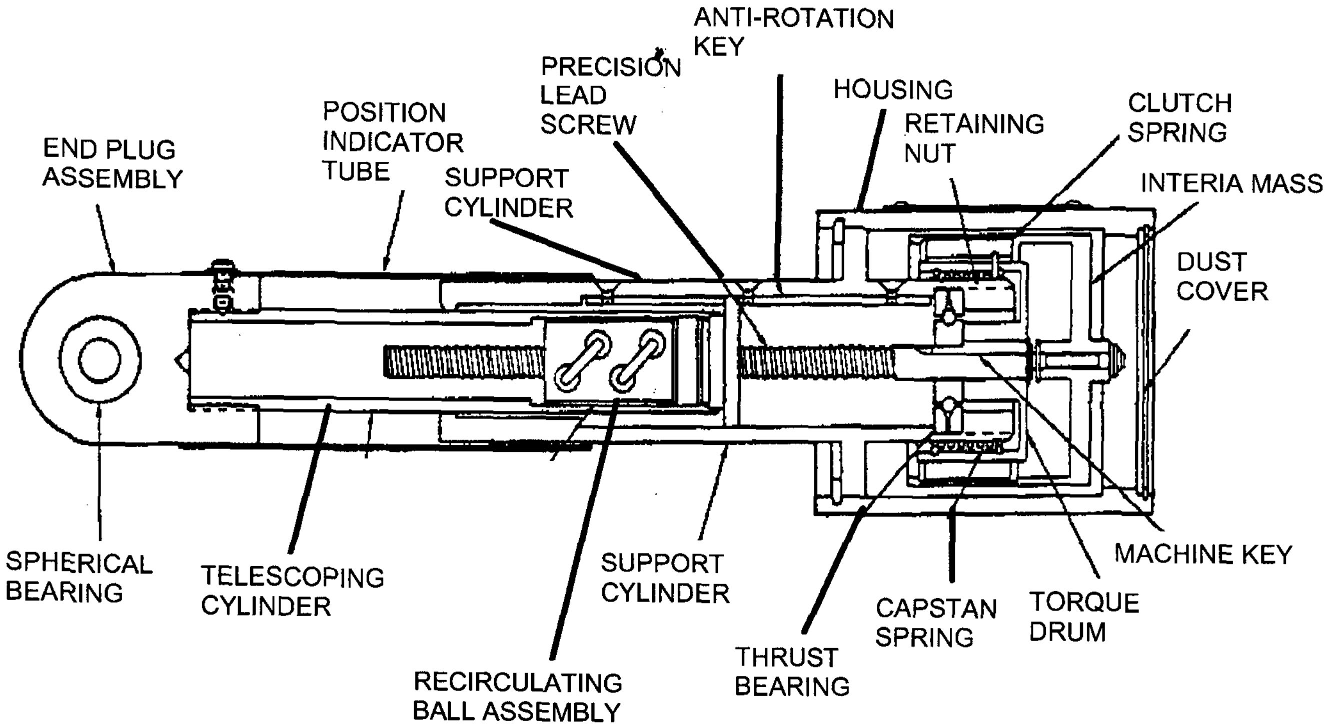

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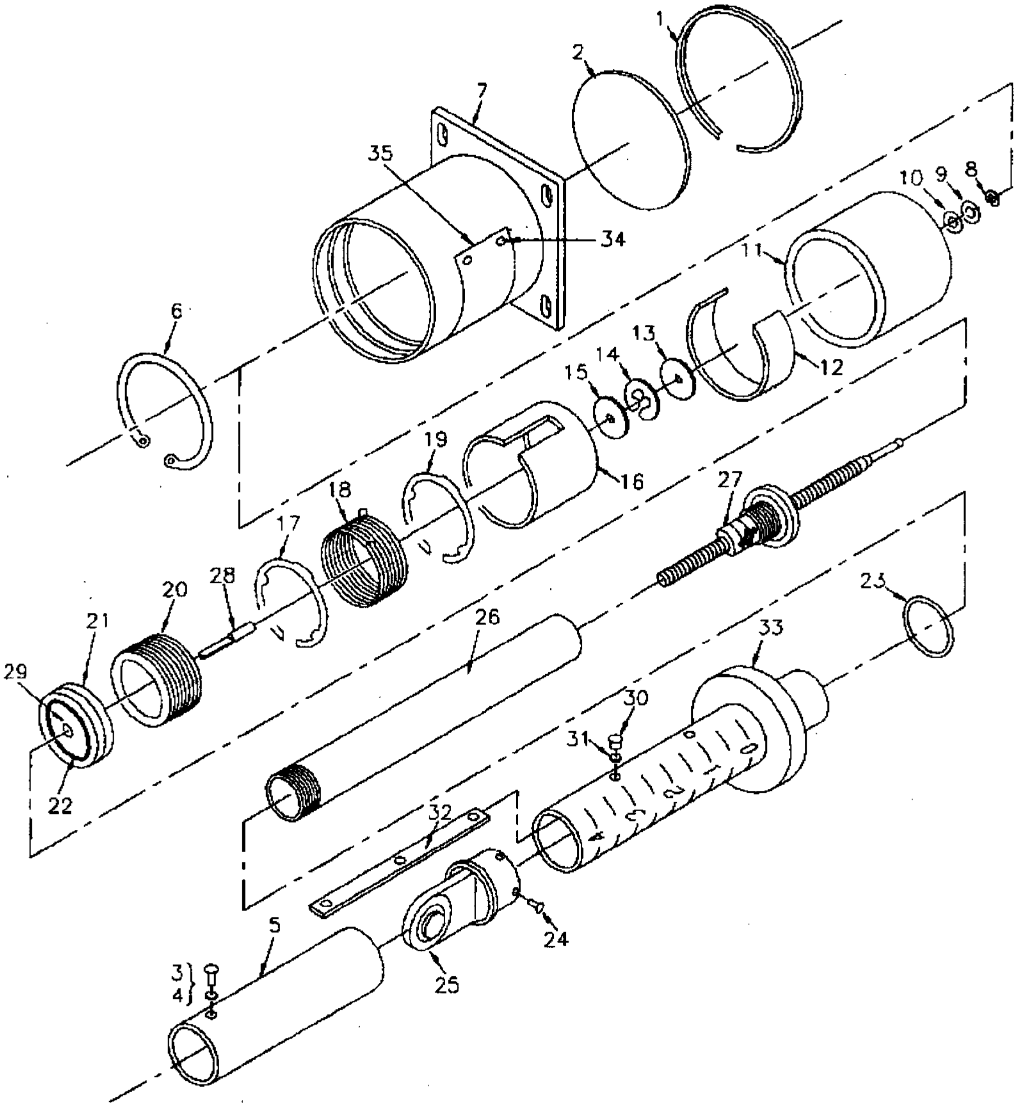
FIGURE 4
PSA-1, PSA-3 AND PSA-10 PARTS



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PSA-1, PSA-3, AND PSA-10 PARTS LIST

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801102-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-1	A
	1801106-05	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-3	B
	1801103-07	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-10	C
1	0911100-84	RING, RETAINING	A
	0911100-80	RING, RETAINING	B
	0911100-96	RING, RETAINING	C
2	1801232-01	COVER, DUST	A
	1801260-01	COVER, DUST	B
	1801217-01	COVER, DUST	C
3	AN503-8-4	SCREW, FILLISTER HEAD	A
	AN501A10-4	SCREW, FILLISTER HEAD	B
	AN501A10-5	SCREW, FILLISTER HEAD	C
4	AN960-8	WAHSER, FLAT	A
	AN960-10L	WASHER, FLAT	B,C
5	1801238-05	TUBE, POSITION INDICATOR	A
	1801267-05	TUBE, POSITION INDICATOR	B
	1801216-05	TUBE, POSITION INDICATOR	C
6	0911100-98	RING, RETAINING	A
	0911100-81	RING, RETAINING	B
	0911100-97	RING, RETAINING	C
7	1801281-05	HOUSING	A
	1801274-05	HOUSING	B
	1801360-07	HOUSING	C
8	0911100-111	RING, RETAINING	A
	0911100-110	RING, RETAINING	B
	0911100-109	RING, RETAINING	C
9	0903100-41	WAHSER, FLAT	A
	0903100-33	WAHSER, FLAT	B
	0903100-39	WAHSER, FLAT	C
10	0903100-23	WAHSER, FLAT	A
	0903100-33	WAHSER, FLAT	B
	0903100-38	WAHSER, FLAT	C
11	1801224-03	INERTIA MASS	A
	1801276-01	INERTIA MASS	B
	1801205-01	INTERIA MASS	C
12	1801288-01	SPRING, CLUTCH	A
	1801272-01	SPRING, CLUTCH	B
	1801201-01	SPRING, CLUTCH	C
13	0903100-41	WAHSER, FLAT	A
	0903100-33	WAHSER, FLAT	B
	0903100-39	WAHSER, FLAT	C

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PSA-1, PSA-3, AND PSA-10 PARTS LIST (CONTINUED)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
14	0911100-99	RING, RETAINING	A
	0911100-100	RING, RETAINING	B
	0911100-101	RING, RETAINING	C
15	903100-42	WAHSER, FLAT	A
	AN960-716	WAHSER, FLAT	B
	903100-43	WAHSER, FLAT	B
	903100-45	WAHSER, FLAT	C
16	1801218-03	DRUM, TORQUE	A
	1801275-03	DRUM, TORQUE	B
	1801206-01	CARRIER, TORQUE	C
17	1801538-01	RING, KEEPER	A
	1801539-01	RING, KEEPER	B
	1801540-01	RING, KEEPER	C
18	1801613-01	SPRING, CAPSTAN	A
	1801614-01	SPRING, CAPSTAN	B
	1801615-01	SPRING, CAPSTAN	C
19	1801538-01	RING, KEEPER	A
	1801539-01	RING, KEEPER	B
	1801540-01	RING, KEEPER	C
20	1801235-01	NUT, BEARING RETAINER	A
	1801262-01	NUT, BEARING RETAINER	B
	1801214-01	NUT, BEARING RETAINER	C
21	1801236-01	RACE, THRUST OUTER (FOR REPLACEMENT ORDER KIT NO. 1811041-01)	A
	1811041-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801236-01)	A
	1801442-01	RACE ASSEMBLY, OUTER (FOR REPLACEMENT ORDER KIT NO. 1811042-01	B
	1811042-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801442-01)	B
	1801443-01	RACE ASSEMBLY, OUTER (FOR REPLACEMENT ORDER KIT NO. 1811043-01	C
	1811043-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801443-01)	C

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PSA-1, PSA-3, AND PSA-10 PARTS LIST (CONTINUED)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
22	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811041-01)	A
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811041-01)	A
	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811042-01)	B
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811042-01)	B
	1801493-02	BALL (0.1860 INCH/40724 MM DIAMETER) (INCLUDED IN KIT NO. 1811043-01)	C
	1801493-03	BALL (0.1865 INCH/40737 MM DIAMETER) (INCLUDED IN KIT NO. 1811043-01)	C
23	0911100-82	RING, RETAINER	A,B,C
24	AN565B8H3	SETSCREW	A
	AN565B1032H4	SETSCREW	B
	AN565B1032H3	SETSCREW	C
25	1801860-01	PLUG ASSEMBLY, END	A
	1801858-01	PLUG ASSEMBLY, END	B
	1801856-01	PLUG ASSEMBLY, END	C
26	1801227-01	CYLINDER, TELESCOPING	A
	1801270-01	CYLINDER, TELESCOPING	B
	1801211-01	CYLINDER, TELESCOPING	C
27	1801382-01	SCREW ASSEMBLY, BALL BEARING	A
	1801324-01	SCREW ASSEMBLY, BALL BEARING	B
	1801384-01	SCREW ASSEMBLY, BALL BEARING	C
28	1801287-01	KEY, MACHINE	A
	1801280-03	KEY, MACHINE	B
	1801298-01	KEY, MACHINE	C
29	1801230-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811041-01)	A
	1811041-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801230-01)	A
	1801264-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811042-01)	B
	1811042-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801264-01)	B
	1801391-01	RACE, INNER THRUST (FOR REPLACEMENT ORDER KIT NO. 1811043-01)	C
	1811043-01	KIT, THRUST BEARING (REPLACEMENT FOR PART NO. 1801391-01)	C

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PSA-1, PSA-3, AND PSA-10 PARTS LIST (CONTINUED)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
30	MS24694-S1	SCREW, FLATHEAD	A,B
	MA24694-S92	SCREW, FLATHEAD	C
31	MS35790-9	WASHER, LOCK	A,B
	MS35790-25	WASHER, LOCK	C
32	1801234-01	KEY, ANTI-ROTATION	A
	1801265-01	KEY, ANTI-ROTATION	B
	1801212-01	KEY, ANTI-ROTATION	C
33	1801226-01	CYLINDER, SUPPORT	A
	1801277-01	CYLINDER, SUPPORT	B
	1801210-01	CYLINDER, SUPPORT	C
34	AN535-2-2	SCREW, DRIVE	A,B,C
35	1801301-01	NAMEPLATE	A,B,C

1.4 Pacific Scientific Mechanical Snubber (PSA-35 AND PSA-100) Design and Operation

Figure 5 is a cross section that represents the PSA-35, and PSA-100 snubbers. Also, Figure 6 shows the part numbers of the snubbers.

The PSA-35 and PSA-100 snubbers are the largest capacity Pacific Scientific snubbers manufactured. Their external configuration is similar but distinctive from other PSC snubbers, in addition to being much larger, by the outside diameter being essentially the same throughout its length.

The snubber consists of a support cylinder assembly, torque carrier assembly, an inertia mass assembly, an adapter nut or transition tube, an end cap assembly, and end cap nut, and a position indicator tube. A dust cover is installed in the adapter nut, or transition tube, to prevent contaminants from entering the arrestor internal mechanisms. The support cylinder assembly includes a support cylinder, a telescoping cylinder, a capstan spring, a recirculating ball assembly, ball bearings, a system of planetary gears, a ring gear and a housing.

The recirculating ball assembly is attached to and travels with the telescoping cylinder, as do the externally mounted end cap assembly, end cap nut and indicator tube. The opposite end of the recirculating ball assembly is keyed to the inner race of the thrust bearing assembly which is coupled to the planetary gear system. The outer race of the ball bearing and the ring gear are fitted into the bore of the support cylinder housing. This arrangement translates rotation of the precision ball screw into rotation of the planetary gears. The capstan and an internally mounted ball bearing are installed in the support cylinder housing at the output side of the planetary gear system. The capstan is keyed to the housing and does not rotate. Installed in the support cylinder housing, but not part of the support cylinder assembly, are a torque carrier assembly, an inertia mass assembly and a capstan spring. The pinion gear of the torque carrier assembly engages the planetary gears. The hub of the torque carrier is supported by the internal bearing of the capstan. The capstan spring is internally contained in the torque carrier shell and rotates with the torque carrier. The hub of the inertia mass assembly is supported in a needle bearing installed in the torque carrier assembly. A clutch spring is installed in the bore of the inertia mass assembly. The lips of the clutch spring are centered on the slot in the inertia mass shell. The tangs of the capstan spring are centered between the lips of the clutch spring. In this manner, the torque carrier assembly is coupled to the inertia mass assembly.

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1.4 Pacific Scientific Mechanical Snubber (PSA-35 AND PSA-100) Design and Operation (Continued)

The operation of these larger size PSA's is generally the same as for the other sizes as described. The use of the planetary gear system permits the use of a reasonable size inertia mass because the gear system rotates the mass at a greater speed than the ball screw turns.

The restraining function of the PSA35 and -100 snubbers is accomplished by translating linear motion of the telescoping cylinder, within the support cylinder assembly, into rotary motion of the output gear train, the torque carrier assembly and the inertia mass assembly. As the snubber is extended or retracted, the telescoping cylinder moves inside the support cylinder. The recirculating ball assembly is fixed to the telescoping cylinder, and the telescoping cylinder is prevented from rotating by the anti-rotation key attached to the stationary support cylinder. Therefore, as the recirculating ball assembly is moved in or out with the telescoping cylinder, the ball screw is forced to rotate, and the torque carrier spins with it. The tangs of the capstan spring drive the inertia mass, and if the speed is changed gradually, the spring does not tighten down on the end of the support cylinder. If the speed changes suddenly, either slowing down or increasing, the inertia mass displaces the tangs of the capstan spring and closes the spring down on the end of the support cylinder, acting as a brake. The arresting action of the snubber is essentially the same as for all the other PSA mechanical snubbers.

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FIGURE 5
PSA-35 AND PSA-100
CROSSECTION

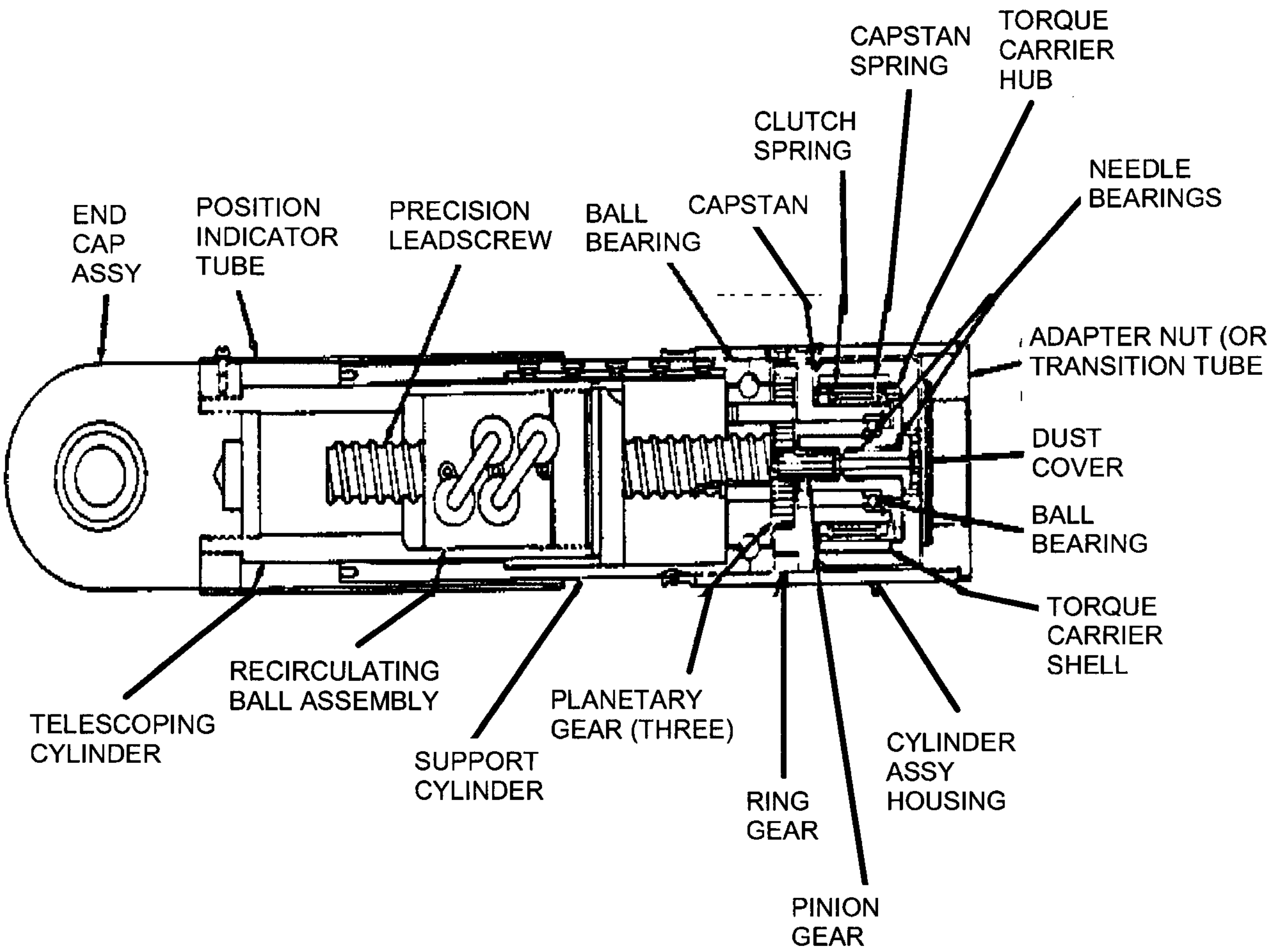

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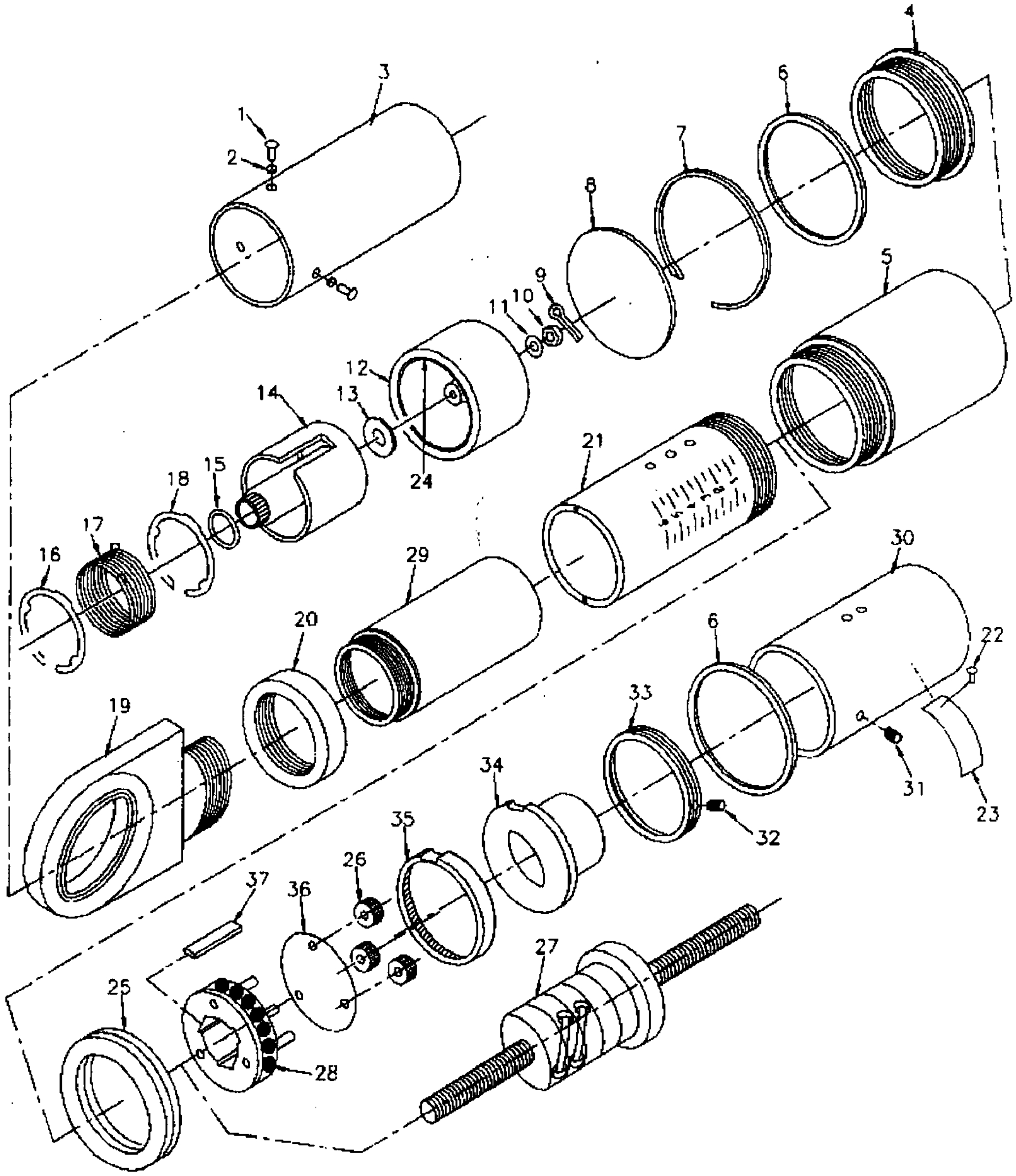
FIGURE 6
PSA-35 AND PSA-100 PARTS



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PSA-35 AND PSA-100 PARTS LIST

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
	1801112-09	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	A
	1801112-11	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	B
	1801112-13	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-35	C
	1801119-09	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	D
	1801119-11	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	E
	1801119-13	ARRESTOR, MECHANICAL SHOCK, MODEL PSA-100	F
1	AN501-416-8	SCREW, FILISTER HEAD	A,B,C
	AN501-561-10	SCREW, FILISTER HEAD	D,E,F
2	AN960-416L	WASHER, FLAT	A,B,C
	AN960-516L	WASHER, FLAT	D,E,F
3	1801455-03	TUBE, INDICATOR	A,B,C
	1801438-03	TUBE, INDICATOR	D,E,F
4	1801506-05	NUT,ADAPTER	A
	1801506-07	NUT,ADAPTER	B
	1801507-05	NUT,ADAPTER	D
	1801507-07	NUT,ADAPTER	E
5	1801480-01	TUBE, TRANSITION	C
	1801478-01	TUBE, TRANSITION	F
6	1801497-01	WASHER, LOCKING	A,B,C
	1801526-01	WASHER, LOCKING	D,E,F
7	0911100-80	RING, RETAINING	A,B,C
	0911100-106	RING, RETAINING	D,E,F
8	1801260-01	COVER, DUST	A,B,C
	1801217-03	COVER, DUST	D,E,F
9	MS24665-152	PIN, COTTER	ALL
10	AN310-4	NUT, CASTELLATED	ALL
11	AN960-416	WASHER, FLAT	A,B,C
	AN960-416L	WASHER, FLAT	D,E,F
12	1801868-01	INTERIA MASS ASEMBLY	A,B,C
	1801863-01	INTERIA MASS ASEMBLY	D,E,F
13	0903100-45	WASHER	D,E,F
14	1801867-01	CARRIER ASSEMBLY, TORQUE	A,B,C
	1801865-01	CARRIER ASSEMBLY, TORQUE	D,E,F
15	0903100-48	WAHSER, (PSA-35)	A,B,C
	1801524-01	RING, WEAR, (PSA-100)	D,E,F
16	1801540-01	RING, KEEPER	A,B,C
	1801611-01	RING, KEEPER	D,E,F
17	1801615-01	SPRING,CAPSTAN	A,B,C
	1801617-01	SPRING, CAPSTAN	D,E,F
18	1801540-01	RING, KEEPER	A,B,C
	1801611-01	RING, KEEPER	D,E,F

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PSA-35 AND PSA-100 PARTS LIST (CONTINUED)

FIG & INDEX NO.	PART NO.	DESCRIPTION	USABLE ON CODE
19	1801546-03	CAP ASSEMBLY, END	A,B,C
	1801545-03	CAP ASSEMBLY, END	D,E,F
20	1801451-03	NUT, END CAP	A,B,C
	1801432-03	NUT, END CAP	D,E,F
21	1801457-77	CYLINDER ASSEMBLY, SUPPORT	A,B,C
	1801430-77	CYLINDER ASSEMBLY, SUPPORT	D,E,F
22	AN535-2-2	SCREW, DRIVE	ALL
23	1801301-01	NAMEPLATE	ALL
24	1801201-01	SPRING, CLUTCH	A,B,C
	1801409-01	SPRING, CLUTCH	D,E,F
25	1801670-01	THRUST BEARING ASSEMBLY (KIT)	A,B,C
	1801673-01	THRUST BEARING ASSEMBLY (KIT)	D,E,F
26	1801465-01	PLANETARY GEARS	A,B,C
	1801419-01	PLANETARY GEARS	D,E,F
27	1801734-01	RECIRCULATION BEARING ASSEMBLY	A,B,C
	1801671-01	RECIRCULATION BEARING ASSEMBLY	D,E,F
28	1801521	BEARING BALLS	A,B,C
	1801525	BEARING BALLS	D,E,F
29	1801456-01	TELESCOPING CYLINDER	A,B,C,
	1801434-01	TELESCOPING CYLINDER	D,E,F
30	1801453-77	HOUSING ASSEMBLY	A,B,C
	1801428-77	HOUSING ASSEMBLY	D,E,F
31	AN565DC524H5	SET SCREW	ALL
32	AN565-E428H4	SET SCREW	A,B,C
	AN565-E524H5	SET SCREW	D,E,F
33	1801477-03	LOCKING RING	A,B,C
	1801445-03	LOCKING RING	D,E,F
34	1801458-01	CAPSTAN	A,B,C
	1801421-01	CAPSTAN	D,E,F
35	1801466-01	RING GEAR	A,B,C
	1801420-01	RING GEAR	D,E,F
36	1801476-01	WASHER PLATE	A,B,C
	1801440-01	WASHER PLATE	D,E,F
37	MS20066-A-353	THRUST BEARING MACHINE KEY	A,B,C
	MS20066-A-256	THRUST BEARING MACHINE KEY	D,E,F

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2.0 The Types and Sizes for the Mechanical Snubbers:

- PSA-1/4, 0.35 Kips, 4 inch stroke (Bergen-Paterson part number 2540-.35 or 2410-.35).
- PSA-1/2, 0.65 Kips, 2.5 inch stroke (Bergen-Paterson part number 2540-.65 or 2410-.65).
- PSA-1, 1.5 Kips, 4 inch stroke (Bergen-Paterson part number 2540-1.5 or 2410-1.5).
- PSA-3, 6 Kips, 5 inch stroke (Bergen-Paterson part number 2540-6 or 2410-6).
- PSA-10, 10 Kips, 6 inch stroke (Located in all units. Pre-NF design Not manufactured any longer)
- PSA-10, 15 Kips, 6 inch stroke (Bergen-Paterson part number 2540-15 or 2410-15).
- PSA-35, 50 Kips, 6 inch stroke (Bergen-Paterson part number 2540-50 or 2410-50).
- PSA-100, 120 Kips, 6 inch stroke (Bergen-Paterson part number 2540-120 or 2410-120).

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3.0 Test Parameters in the Snubber Test Machine Program:

The following parameters shall be verified to work on the test machine, with the associated snubbers, and the accompanying plot shall be located as close to the center of the graph as possible. If the plot does not show in the center of the graph the following parameters may be changed to center the plot and give the best looking plot available.

- Valve Open - This value is in percent of command output. If the operator wishes to start the valve sooner the percent value may be reduced, which will require the valve to open sooner causing the command ramp to "jump" up to an initial value and overcome the dead band.
- Valve End - The valve end value allows the operator to set an endpoint for the proportional valve opening at less than 100 percent full open. If the operator wishes the profile to extend or reduce this value should be increased or decreased, as necessary. This value has to be controlled enough that the snubber will lockup and bleed, prior to the end of the test. This value controls the ramp profile in the activation tests.
- Ramp Duration - This value sets the time duration of the ramp between valve start and valve end. This value may be decreased, which moves the plot to the left on the graph. In the acceleration tests this value is limited to .45 sec maximum.
- Load Duration - This is the time that the valve will remain at the valve end position, after the ramp time has elapsed. Adjusting this value "up" will assure that the complete test will show on the graph.

TPYE	PSA 1/4	PSA 1/2	PSA 1	PSA 3	PSA 10	PSA 35	PSA 100
KIP RATING	.35	.65	1.5	6	15	50	120
STROKE	2.5	2.5	4	5	6	6	6
ACTIVATION RATE	0	0	0	0	0	0	0
RELEASE RATE	0	0	0	0	0	0	0
ACCELERATION RATE	.02	.02	.02	.02	.02	.02	.02
DRAG FORCE LIMIT	5	5	5	5	5	5	5
TEST LOAD	60	60	50	60	60	50	50
PRESSURE BOOST	100	100	100	100	120	100	100
VALVE START	0	0	0	0	0	0	0
VALVE END	100	100	100	100	100	100	100
DRAG SPEED	2	2	2	2	2	2	2
RAMP DURATION	.35	.35	.25	.25	.24	.35	.35
LOAD DURATION	.35	.35	.25	.25	.24	.35	.35
BENCH (B)IG/(S)MALL	S	S	S	S	B	B	B

SERVICE LIFE MONITORING RECOMMENDATIONS

Service life monitoring enables plant personnel to gain knowledge of the plant's operating environment and the associated capabilities of snubbers. Service life monitoring also helps to identify and control problem applications and establish practical scheduled maintenance intervals based on realistic expectations of snubber aging.

Current practices call for periodic visual examinations and functional testing of both hydraulic and mechanical snubbers. Visual examination of 100% of all safety-related snubbers is performed on a standard inspection interval controlled by NRC Generic Letter 90-09. The inspection interval may be shortened or lengthened depending on the number of inoperable snubbers found. The examination plan assumes a constant frequency of occurrence of snubber failures and is intended to ensure that no more than one snubber is inoperable at a given time. A plant can either maintain a low snubber failure rate or inspect snubbers more frequently.

Current practices also call for testing of a sample batch of snubbers during each operating cycle. Testing of an additional sample for each inoperable snubber is also normal practice. In contrast to the visual examination plan, the functional test plan is not time-related. It simply ensures a given snubber operability level at the time the testing is completed.

As plant specific knowledge of snubber aging is gained through effective service life monitoring, it is anticipated that less emphasis will be placed on such statistical plans. Our Technical Requirements Manual does not require a specific service life monitoring program to be established. This is handled by our functional testing, visual examinations and other maintenance history for the snubbers. The ASME OM Code (Subsection ISTD) and NRC NUREG/CR-5870 give recommendations for establishing a service life monitoring program.

Snubbers located in isolated severe environments should be separated from the general population and managed on a case-by-case basis. It may be desirable to group the general snubber population into two or more sub-populations with separate service lives.

APPENDIX G
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SERVICE LIFE MONITORING RECOMMENDATIONS

1.0 Purpose

Degradation due to service environment and maintenance errors can adversely affect snubber performance. This Appendix discusses methods and considerations that can be used to predict and reevaluate snubber service life to optimize snubber availability during plant operation. A service life monitoring program should be based on knowledge of the operating environment, snubber design limits and service record.

2.0 Predicted Service Life

Before entering a snubber into service, its service life should be conservatively predicted, based on manufacturer recommendations and design review.

Manufacturer recommendations may include seal and fluid replacement intervals for hydraulic snubbers and critical parts or snubber replacement intervals for mechanical snubbers. Such intervals may vary, depending on the application.

Snubber design review should consider materials, design features and the plant operating environment. Evaluation of the effects of the environment on critical snubber parts such as seals, hydraulic fluid, lubricants, platings, etc., should be particularly emphasized.

3.0 Service Life Reevaluation

Service life reevaluation should include the following considerations.

3.1 Knowledge, Determination and Documentation of the Operating Environment

Service life monitoring takes into consideration the capability of the various snubber models to endure the full range of plant environments. Actual plant operating environments can differ significantly from the original plant design specifications. Some snubbers may be subjected to localized high temperatures that are not representative of the general snubber population. Such applications may require augmented inspections or more frequent snubber overhaul or replacement than originally predicted. Indicators of severe operating conditions can often be identified during snubber overhauls and other maintenance related activities.

3.1 Knowledge, Determination and Documentation of the Operating Environment (Continued)

The operating environment for the majority of snubbers may be significantly less severe than described in the plant design specifications. Therefore, unnecessary overhauls or replacements may increase the number of failed or degraded snubbers due to handling or maintenance errors.

It is important that the operating environment be identified and appropriate maintenance intervals established for the various snubber applications in the plant and appropriate applicable service life established. Environmental parameters may include the following:

- temperature
- vibration
- transient loading
- radiation
- humidity
- airborne contaminants (e.g., sand and dusts)
- leakage of adjacent pipes or equipment

Severe environments may be identified by plant operating data, direct measurement of environmental parameters, evaluation of installed location (e.g., proximity to high temperature components) or by examination of snubbers (or snubber parts).

Determining specific environmental information often involves specialized instrumentation and equipment that would be impractical for use at every snubber location. Such equipment should be used in applications where moderate to severe environments are anticipated or as a diagnostic aid in determining the cause of snubber degradation or failure.

3.1.1 Direct Measurement of Environmental Parameters

Various types of instrumentation and equipment are available for direct measurement of environmental parameters such as temperature, vibration, radiation and humidity. Such equipment may be used for specific snubber locations where severe environments are expected or as an aid in determining the cause of snubber degradation.

1. Temperature

Continuous temperature recording devices are available to indicate the general area temperatures within the plant (which often vary by elevation) or to measure local snubber or component temperatures. Temperature sensitive tape may be placed directly on the snubber to determine the maximum temperature. One shortcoming of this approach is that a time/temperature profile is not provided. Contact and non contact temperature devices (e.g., infrared type) are also available.

2. Radiation

Normal radiation levels of an operating plant do not usually contribute significantly to snubber degradation. This is probably due to the following considerations:

- actual in-plant radiation levels are, in most cases, less than was originally anticipated
- the snubber body provides a significant amount of shielding
- originally anticipated radiation effects were based upon 40-year dose; in actuality, snubber parts that are sensitive to radiation degradation are replaced at intervals that are significantly less than 40 years.

Data pertaining to plant radiation levels can generally be obtained from Radiological Control area surveys. Measurements of radiation levels specifically for service life monitoring is not recommended except in evaluating the cause of snubber degradation in cases where other causes have been ruled out.

3.1.1 Direct Measurement of Environmental Parameters (continued)

3. Vibration

Vibration may be continuous, in which case snubbers may degrade in as little time as one operating cycle. Vibration may also be intermittent (e.g., during pump startup), in which case it may be undetected for long periods and result in long-term degradation of the snubber. The available methods for detecting and measuring vibration vary from simple visual observation, detection by feel, portable vibration measuring instrumentation and remote vibration measuring equipment.

Snubbers subject to vibration can often be detected by visual examination. Metal filings, darkened hydraulic fluid, deformed connecting pins, elongated attachment holes and fretting of mating parts are all signs of vibration effects.

4. Transients

As with vibration, the existence of dynamic load transients may be identified during routine snubber inspections, augmented inspections and failure evaluation. Deformed structural members, jammed snubbers and deformed internal parts are all potential indicators of dynamic overloading. Inplace devices such as load measuring clevis pins are available for monitoring snubber loads where such transients are suspected.

3.2 Knowledge of Operating Environment Effects

Reevaluation of a snubber service life should include a thorough knowledge of the effects of various operating environments on snubber performance. Such knowledge may not be readily available from the manufacturer and may require engineering evaluation, including monitoring of trendable degradation parameters for snubbers removed from service. This might include periodic measurement of potentially trendable test parameters (e.g., drag force) for selected snubbers. Periodic disassembly and evaluation of snubber internal parts (e.g., seals, springs, fluid, etc.) may also be required.

Degraded snubbers may be identified by visual examination of snubbers or their parts, by sampling of hydraulic fluid or evaluation of characteristics including time traces (e.g., load and velocity), obtained during testing.

3.2.1 Managing Snubbers in Severe Operating Environments

Significant environmental stressors that can effect snubber performance include overloading, vibration, elevated temperature, moisture, chemicals and radiation. Snubbers operating in severe environments can be identified as plant operation continues. Such applications are often not identified until the snubbers are functionally tested. This supports the need for some random functional testing, but the extent of functional testing required by the Technical Requirements Manual may not be necessary as plants gain empirical knowledge pertaining to the plant operating environments and the associated snubber capabilities.

Snubber failures involving severe operating environments may be mitigated by conducting augmented inspections, periodic maintenance, periodic replacement with like kind, retrofitting with snubbers more suitable for the environment or eliminating the snubber by approved engineering analysis methods.

3.2.2 Augmented Surveillance Practices

A number of practices may be used for evaluating snubbers for degradation and identifying operating environments. Since evaluation methods often do not employ quantifiable parameters, judgment is required on the part of the evaluating person. Experience of the evaluating person is therefore important.

1. Hand Stroking

   Probably the most common "hands-on" evaluation method is hand stroking of mechanical snubbers. This method is often used to identify snubbers that are damaged or jammed due to transients. In using this method, the evaluating person removes the connecting pin at one end of the snubber and slowly strokes the snubber while feeling and listening for abnormalities such as intermittent or continuous excess noise or resistance.

   Using this method, an experienced person can often identify impending failure. An example, during hand stroking of a mechanical snubber, is periodic resistance accompanied by a chaffing sound for each revolution of the inertia mass. This indicates binding caused by lack of concentricity of the rotating parts. Irregular, intermittent noise and resistance indicates surface discontinuities on the lead screw.

3.2.2 Augmented Surveillance Practices (Continued)

2. Rotation of Snubbers in Place

   Jammed snubbers (i.e., snubbers unable to allow free thermal motion) may often be identified by attempting to rotate the snubber about its spherical end attachment bearings. If the snubber is not free to rotate, it is possible that axial loading exists, resulting in jamming or premature lockup. It should be noted that this method is most effective for snubbers with a load capacity of 3,000 lbs. or less. Normal friction in the bearings often prevents rotation of larger sizes.

3. Hand Detection of Vibration

   Hand detection of vibration, by placing a hand on the snubber during operation, is a useful technique for evaluating accessible snubbers.

4. End of Outage Examination

   Just prior to startup, reinspection of snubbers that are susceptible to damage due to outage-related activities will reduce the probability of plant operation with inoperable snubbers. Future verification that consequent failures were not the result of service-related influences would be more difficult.

3.2.3 Trending

Progressive degradation, in the general snubber population (i.e., those snubbers not subject to rapid degradation), should be monitored by trending applicable degradation parameters for a selected number of snubbers that are representative of the plant operating environment. Some important considerations in this regard are listed below:

- The establishment of baseline data is essential for identifying trends. Data to be used for identifying trends should be sufficiently accurate to demonstrate trends.

3.2.3 Trending (Continued)

- Trending parameters that relate directly to the anticipated aging failure mode should be used. Such degradation parameters might include compression set for elastomeric seals for hydraulic snubbers or average drag force for mechanical snubbers.

  An inappropriate monitoring parameter is the use of functional test data,(i.e., locking velocity and release rate) for monitoring or trending of seal degradation. Although functional test results can be affected to some extent by seal degradation, the primary aging failure mode for snubber seals (i.e., loss of low pressure seal integrity) would not be reflected in the functional test data.

- Acceleration threshold (activation velocity) in acceleration-limiting mechanical snubbers is a potentially trendable parameter that may indicate internal snubber degradation. A decreasing acceleration threshold may indicate internal corrosion or internal friction between the inertia mass and its spindle. An increasing acceleration threshold may indicate weakening of the capstan spring tangs as a result of wear or a decrease in friction between the capstan spring and its braking surface.

- Although changes in active hydraulic snubber parameters [i.e., locking velocity and bleed(release) rate] can indicate snubber degradation, these parameters are not considered practical trending parameters for monitoring progressive degradation.

- Reservoir fluid level is the most appropriate parameter for monitoring snubber fluid leakage.

3.2.4 Testing

The following functional test parameters are normally measured during inservice testing:

- Activation Velocity: Locking velocity for poppet-valve hydraulic snubbers. Acceleration threshold for acceleration-limiting mechanical snubbers.
- Release Rate: Snubber velocity at a given load, after snubber activation.
- Drag Force: Snubber resistance load at a given stroke velocity.
- Breakaway Force: Force required to initiate snubber motion.

These parameters are also useful in identifying potential degradation or determining the cause of snubber failure.

3.2.4 Testing (Continued)

1. Evaluation of Test Results

   Since existing test plans are statistically based on the number of failures, test results are often evaluated on only a pass/fail basis. Most test machines provide a continuous trace of load and velocity for both activation and drag force tests. Such traces often contain information useful in identifying snubber degradation. During mechanical snubber drag force (i.e., the number of load spikes, consistency of the load spikes, duration of load spikes, noise, variations in drag force with stroke position and directional sensitivity) are all useful in identifying potential snubber degradation or impending snubber failure. For hydraulic snubbers, traces can be used to identify air in the snubber or a clogged bleed orifice.

2. As-Found Testing

   As-Found testing of snubbers removed from service can identify degradation due to severe operating environments. A considerable amount of information can be obtained by conducting post-service functional tests on snubbers removed from service. Such tests are recommended any time a snubber is removed from service, regardless of whether or not the snubber is to be reinstalled. This is a requirement of the Technical Requirements Manual at BFN.

3. Diagnostic Testing

   Diagnostic tests are specifically designed to obtain useful information about the condition of a particular snubber, beyond what may be available from routine testing. Diagnostic testing may often be helpful in identifying a failure or degradation mechanism before the snubber is disassembled. Repeat tests are helpful in determining the repeatability of a given anomaly. It may sometimes be desirable to vary test parameters (i.e., applied load, drag force velocity or test time duration) in order to observe the effect on snubber performance.

3.2.4 Testing (Continued)

4. Trending Test Results

Trending is a useful tool for monitoring progressive snubber degradation. If test data are to be used for trending, the following should be considered:

- Because the prevalent failure mode is failure to allow free thermal motion, a potential trending parameter for mechanical snubbers is drag force. This is supported by test data obtained that suggest an increase in drag force with service time for mechanical snubbers.

It is important that test data to be used for trending are consistently obtained using the same type of test machine, under the same conditions. The data from the same snubber should be used for comparison purposes.

Administrative limits for functional test results are intended to ensure replacement or repair of a given snubber before failure. It is important to have a reasonable indication that the selected test parameter is progressing toward the failure limit. Overly restrictive administrative limits can have the negative effect of limiting the amount of data available for trending. They can also encourage replacement of reliable snubbers. If test data are obtained for a different set of snubbers at each refueling outage, then the test results are not appropriate for trending. If snubbers are tested on different types of test machines, the test data are generally not adequate for identifying trends.

Another important consideration involves defining the test parameter. A test parameter may be defined in different ways for the same parameter. A test parameter must be defined both from the standpoint of snubber operability (i.e., for testing) and for service-life monitoring (i.e., for trending).

5. Test Equipment

The types of snubber test equipment used in the industry varies considerably. Some provide only a single value for a given test parameter (i.e., load or velocity) while others provide a continuous trace of the parameter versus time. The operation of some test equipment is totally manual, while others are fully automated. It is recommended that functional test equipment be provided with a data acquisition system (i.e., analog or digital) that is capable of providing a continuous trace of load and velocity versus time for the duration of the test. Information from such traces is useful in detecting degradation and identifying failure mechanisms.

3.2.4 Testing (Continued)

5. Test Equipment (Continued)

   Many test machines are totally automatic. Automatic test machines may be advantageous for required testing because operator bias is minimized. Data from automatic testers are generally acceptable for trending purposes. For diagnostic testing the test operator should be able to vary the level of various test parameters for exploratory purposes.

   It should be noted that when a snubber is tested in a different type of test machine than the one previously used, a number of new variables (i.e., test control methods and parameters, data acquisition systems, etc.) are introduced that may complicate the identification of trends. For this reason, trending tests are most effectively conducted using the same test machine as well as the same test methods.

3.2.5 External Seal Leakage Detection and Leakage Rate Determination

Minor seal leakage is common for many snubber types and applications. A number of influences can cause seal leakage. A leaking snubber does not necessarily imply inoperability nor does it necessarily require immediate snubber overhaul.

Measurement and trending of reservoir fluid level is probably the most practical approach to monitoring for external seal leakage. For this reason, reservoir fluid level should be recorded whenever fluid is added.

The location of seal leakage in many cases may be obvious by visual observation. In some cases the precise location of the seal leakage may require a time consuming follow-up evaluation.

It should be noted that in many cases, seal leakage can be the result of improper snubber assembly, defective parts, etc. A practical method for checking for seal leakage following snubber overhaul is to place the snubber on an absorbent (paper) pad, where it can be observed for a period of time, approximately 1 hour, prior to installation.

3.2.6 Visual Examination

Snubbers, at BFN, are visually examined in accordance with the Technical Requirements Manual. The intent of the examinations are to identify characteristics that might indicate snubber inoperability. Service-life monitoring examinations may be conducted at the same time as those required by the Technical Requirements Manual or separately. The qualification of personnel for such examinations is critical.

Visual characteristics, that would provide information in regard to service degradation, are listed below. These snubber attributes may be used to define a visual examination checklist for service-life monitoring.

- Deformed structural member or piston rod
- Loose or missing threaded fasteners
- Cold or hot position varies from specified value
- Evidence of corrosion
- Evidence of solid deposits (e.g., boric acid) from leaking components
- Loss of hydraulic fluid since previous visual examination
- Metal filings on or in the vicinity of the snubber
- Observed fluid leakage
- Evidence of significant dark (i.e., black or dark brown) material deposit on piston rod
- Rod wiper adhered to piston rod
- Abnormal color of hydraulic fluid
- Wear or deformation of clevis pins
- Elongation of attachment holes
- Evidence of wear on support cylinder
- Cracked or deformed fluid reservoir
- Evidence of foreign material (e.g., water, solid particles, etc.) in hydraulic fluid
- Discoloration of metallic parts due to elevated temperature

3.2.7 Root-Cause Evaluation of Degraded or Failed Snubbers

Failures often result from influences (i.e., maintenance activities, construction activities and manufacturing defects) not related to service time or environment. It is important to ensure that service life, when based upon service history, is not unjustifiably influenced by such failures or degradation. Snubbers that failed inservice examinations or tests, or snubbers removed from service due to excessive degradation, should be evaluated to determine the root cause of the degradation or failure.

3.2.7 Root-Cause Evaluation of Degraded or Failed Snubbers (Continued)

Failure evaluation data sheets should include information pertaining to failure mode, failure mechanism, environment, service time, abnormal conditions, visual observations, test results and test observations. Data sheets should not utilize a format that might lead the examiner to a potentially incorrect failure cause (e.g., a checklist of failure causes).

Diagnostic testing may be useful to identify the failure or degradation mechanism.

3.2.8 Shortening or Extending Service Life

It may be necessary to shorten the service life of snubbers subjected to severe environments, such as excessively high temperatures and vibration. Snubbers in severe environments may require augmented surveillance, including “hands-on” evaluations (e.g., hand stroking) or inplace monitoring.

Where there has been minimal degradation due to the service environment, it may be appropriate to extend the previously established service life. Service life extension should be based on a technical evaluation of the snubber performance that includes knowledge pertaining to the current level of service-related degradation as well as to the degradation rate. Service life extension evaluations might include monitoring degradation parameters (i.e., seal compression set in hydraulic snubbers, drag force in mechanical snubbers or operating experience in a similar environment).

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HYDRAULIC SNUBBER FAILURE ANALYSIS APPROACH

1.0 GENERAL

In performing any snubber analysis a full investigation should be performed prior to making any determination of the failure cause. This should be done since there may be very subtle causes, which can be masked by not performing a slow and methodical investigation. All parts should be match marked prior to disassembly, since the disassembly of the snubber may destroy evidence of the true apparent cause of the snubber failure. In this approach a failure denotes a snubber not meeting its functional test acceptance criteria. The test data may show that the snubber is degraded or that it is a functional failure.

If solvents are required during the performance of the investigation, only approved solvents should be used to clean the parts.

2.0 Snubber Location History Data

A. Give a general history of the snubber location using the following as a guideline:

- Any previous functional test or visual examinations
- Snubber location in the plant
- Snubber installed orientation
- Does the snubber have a transition tube kit or a forward bracket installed? If a transition kit is installed what is the pin-to-pin dimension?
- Which end of the snubber (transition tube/forward bracket or the snubber body) is attached to the pipe?

B. Review any and all previously performed snubber visual examination and functional test data.

C. Perform a field walk down of the snubber location to determine any adverse environmental conditions, such as:

- Is the snubber in a location where it could be hit, kicked or stepped upon during maintenance activities?
- Are there any signs of pipe leakage (water, steam, etc.) in the area?

2.0 Snubber Location History Data (Continued)

D. Review the piping system records to determine if any transient events have occurred in this section of piping.

E. Review the piping stress analysis to determine the design loading conditions of this location, the pipe support orientations, locations and the relative stiffness of the piping system. Some examples are:

- Is this location designed to take water hammer loads or other transient loads and did one occur?
- Is this location subject to pipe vibration?
- Is this location required for seismic or is it only required for operational transient loads?

F. Review the piping stress analyses to determine if there are other snubbers subject to the same failure mode. An example is, if a snubber failure occurred on the “A” loop is there a similar location on the “B” loop?

G. Check the environmental data for the snubber location:

- Harsh or mild environment
- Temperature range
- Radiation dose
- Humidity

3.0 External Snubber Evaluation for All Size Hydraulic Snubbers

In almost every case, the evaluation performed on the exterior of the snubber can give clues to the nature of the failure. Following are some things which should be looked at and evaluated during the snubber evaluation.

A. Record the following data:

- Snubber size
- Snubber serial number
- Year of manufacture
- Manufacturer’s part number
- Evaluation date

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3.0 External Snubber Evaluation for All Size Hyrdaulic Snubbers (Continued)

B. Check the condition of the spherical bearing on both ends of the snubber:

Note: A bound or "frozen" spherical bearing can put unanalyzed forces into the snubber during thermal movements, causing internal stress or damage.

- Can they be moved by hand?
- Do they "squeak" when they are moved?
- Is there foreign material on the bearings?
- Are they rusty?
- Are the spherical bearings staked in place?
- Any signs of deformation?

C. Is there any physical damage to the snubbers' externals:

- Ding marks on exterior surfaces
- Welding arc marks on exterior surfaces

D. Are there any foreign materials on the exterior of the snubber? If so, would they interfere with the operation of the snubber?

- Duct tape
- Insulation materials
- Corrosion products
- Dirt or debris
- Paint or other coatings

E. Check the external surfaces of the snubber for any signs of discoloration due to excessive temperatures.

F. Fully extend the snubber, if possible, and denote any wear or other types of marks are found. The location and measurement (length, width and direction) of these marks and the actual snubber orientation during operation can be a vital clue as to what was happening to the snubber during operation.

3.0 External Snubber Evaluation for All Size Hydraulic Snubbers (Continued)

One important aspect is to determine exactly what the snubber settings were prior to the failure and what the snubber settings were at the time of the failure. Some utilities perform snubber measurements from a fixed point on the snubber. These measurements are recorded during the visual examinations, as well as, being documented in the Work Orders (WO) that remove the snubber from the piping system. These measurements are usually documented to the nearest 1/32nd of an inch. The importance of these measurements is that the evaluator can measure any wear marks found on the snubber and correlate the location and lengths of these wear marks to the actual snubber settings. This information can aid the evaluator in determining if these wear marks are due to the normal snubber movements (cold or hot setting) or due to vibration in either the hot or cold position.

G. Check the retainer ring at the housing to ensure that it was installed correctly (flat side down).

H. Check the connection of the transition tube kit or the forward bracket to the snubber.

- Is the tie wire intact?
- Has the transition tube loosened from the backing plate?

I. Slowly stroke the snubber by hand, if possible.

- Orient the snubber, as best as possible, to the orientation that the snubber was in the field prior to stroking.
- Record any rough spots and the location (stroke location).
- Record any noises heard.
- Did the snubber stroke under its own weight or was force needed to be applied to stroke the snubber? Was the applied force excessive?
- Did the snubber "stick" at any point in the stroke?
- Did any rough spots in the stroke correspond to any mark locations?

J. Match mark the transition tube kit or forward bracket to the snubber body and remove the transition tube kit or forward bracket.

Throughout the disassembly process, all parts should be checked for any signs of contamination, damage or wear.

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4.0 Internal Snubber Evaluation for All Size Hydraulic Snubbers

The evaluation guidelines that follow will highlight the prime areas of concern for the snubber components. The following instruments may be used for the evaluation and in particular when any doubt persists as to the cause of the failure.

- Flat machinist's Surface Plate
- Surface Comparitor/Surface Profilometer
- Dial bore gauges
- Plug gauges

4.1 Evaluation of the Snubber Reservoir:

Using the appropriate plant procedures, remove the reservoir hold down screws and lift the reservoir from the control valve assembly and snubber body. After removal perform the following inspections and evaluations:

- Inspect the "O" Ring seal between the reservoir and the control valve assembly for deterioration, cuts or other damage.
- Inspect the matting surfaces between the reservoir, the control valve assembly and the snubber front head for rust, pits, scratches and straightness.

Match mark each piece and disassemble the reservoir in the following order and perform the inspections and evaluations as follows:

- Remove the tie rods from the reservoir and inspect the threads of the rods and nuts.
- Remove the rear cap and inspect the tube ends, the "O" Ring and the "O" Ring contact surfaces.

Release the pressure from the reservoir piston spring and remove the piston and spring. Inspect the reservoir parts as follows:

- Remove and inspect the reservoir piston packing for any imperfections, degradation or nicks.
- Inspect the reservoir piston sealing areas for rough surfaces or nicks.
- Inspect the piston and reservoir tube contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, discard the part.

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4.1 Evaluation of the Snubber Reservoir: (Continued)

- Inspect the spring for mechanical damage, breakage or corrosion. If any are evident discard and replace the part.

Release the pressure from the reservoir piston spring and remove the piston and spring. Inspect the reservoir parts as follows: (Continued)

- Remove and inspect the reservoir bleeder screw threads.
- Inspect the "O" Ring and sealing surface under the screw head.

4.2 Evaluation of the Snubber Control Valve Assembly:

Using the appropriate plant procedures, remove the control valve assembly hold down screws and lift the control valve assembly from the snubber body. After removal perform the following inspections and evaluations:

- Inspect the "O" Ring seal between the control valve assembly and the snubber body for deterioration, cuts or other damage.
- Inspect the mating surfaces between the control valve assembly and the snubber rear cap for rust, pits and scratches.

Match mark each piece, disassemble the control valve assembly and perform the inspections and evaluations as follows:

- Remove and inspect the threads, "O" Rings and sealing surfaces of the 3 SAE port plugs for deterioration, degradation, rust, nicks or pits.
- Remove the compression poppet stop and plug, the extension connector tube and inspect the threads, "O" Rings and sealing surfaces for deterioration, degradation, rust, nicks or pits.
- Remove and inspect the compression and extension poppets for degradation, rust, nicks or pits on the head and the conical bleed groove area.
- Inspect the compression and extension poppet seat areas for degradation, rust, nicks or pits.
- Inspect the poppet springs for mechanical damage, weakness, breakage or corrosion. If any are evident discard and replace the part.
- Remove the relief valve plug, ball and spring and perform the same inspections as listed above.

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4.3 Evaluation of the Snubber Main Body:

Using the appropriate plant procedures, disassemble the main snubber body. After removal match mark each piece and perform the inspections and evaluations as follows:

- Remove the tie rods from the main snubber body and inspect the threads of the rods and nuts.
- Remove the rear cap and inspect the tube ends, the "O" Ring and the "O" Ring contact surfaces.
- Remove and inspect the main piston rings for any imperfections, degradation or nicks.
- Inspect the main piston sealing areas for rough surfaces or nicks.
- Inspect the piston and main cylinder tube contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, discard the part.
- Remove the front head and inspect the tube ends, the "O" Ring and the "O" Ring contact surfaces.
- Inspect the rod bearing gland contact areas for surface imperfections, nicks or rough spots. If nicks or rough spots persist on the largest diameter, discard the part.
- Remove and inspect the rod bearing gland rod packing contact areas for surface imperfections, nicks or rough spots.
- Remove and inspect the piston rod wiper and contact surface for imperfections, nicks or rough spots.
- Remove and inspect the threads, "O" Rings and sealing surface of the front head port plug for deterioration, degradation, rust, nicks or pits.

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HYDRAULIC SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

HYDRAULIC SNUBBERS		
FAILURE MODE	**INDICATIONS**	**FAILURE CAUSE**
LOW FLUID LEVEL	LEAKAGE	OVER LOAD OR TRANSIENT
	IMPROPER FILLING AND PURGING	MAINTENANCE OR MANUFACTURE
LOW LOCKING VELOCITY	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	LOW TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHNAGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE
	INADEQUATE PURGE	MAINTENANCE
	INCORRECT VALVE PARTS	MAINTENANCE OR MANUFACTURE
LOW BLEED FATE	CLOGGED BLEED ORIFICE	ENVIRONMENT OR MAINTENANCE
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	LOW TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHNAGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE OR MANUFACTURE
	INADEQUATE PURGE	MAINTENANCE
HIGH LOCKING VELOCITY	AIR IN FLUID	MAINTENANCE
	INTERNAL SEAL BY-PASS	MAINTENANCE
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE, MANUFACTURE, UNKNOWN OR TESTING
	HIGH TEST TEMPERATURE	MAINTENANCE
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHNAGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE
	INADEQUATE PURGE	MAINTENANCE

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HYDRAULIC SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

HYDRAULIC SNUBBERS		
FAILURE MODE	**INDICATIONS**	**FAILURE CAUSE**
HIGH BLEED RATE	AIR IN FLUID	MAINTENANCE
	INTERNAL SEAL BY-PASS	MAINTENANCE OR MANUFACTURE
	CLOGGING DURING CALIBRATION	MAINTENANCE, MANUFACTURE, UNKNOWN OR TESTING
	FIELD TAMPERING	MAINTENANCE
	IMPROPER INITIAL SETTING	MAINTENANCE
	HIGH TEST TEMPERATURE	TESTING
	IMPROPER TEST	TESTING
	FLUID VISCOSITY CHNAGE	ENVIRONMENT
	INCORRECT FLUID	MAINTENANCE OR MANUFACTURE
	INADEQUATE PURGE	MAINTENANCE

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MECHANICAL SNUBBER FAILURE ANALYSIS APPROACH

1.0 GENERAL

In performing any snubber analysis a full investigation should be performed prior to making any determination of the failure cause. This should be done since there may be very subtle causes, which can be masked by not performing a slow and methodical investigation. All parts should be match marked prior to disassembly, since the disassembly of the snubber may destroy evidence of the true cause of the snubber failure. In this approach a failure denotes a snubber not meeting its functional test acceptance criteria. The test data may show that the snubber is degraded or that it is a functional failure.

If solvents are required during the performance of the investigation, only approved solvents should be used to clean the parts.

2.0 Snubber Location History Data:

A. Give a general history of the snubber location using the following as a guideline:

- Any previous functional test or visual examinations
- Snubber location in the plant
- Snubber installed orientation
- Does the snubber have a transition tube kit or a forward bracket installed? If a transition kit is installed what is the pin-to-pin dimension?
- Which end of the snubber (transition tube/forward bracket or the snubber body) is attached to the pipe?

B. Review any and all previously performed snubber visual examination and functional test data.

C. Perform a field walk down of the snubber location to determine any adverse environmental conditions, such as:

- Is the snubber in a location where it could be hit, kicked or stepped upon during maintenance activities?
- Are there any signs of pipe leakage (water, steam, etc.) in the area?

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2.0 Snubber Location History Data: (Continued)

D. Review the piping system records to determine if any transient events have occurred in this section of piping.

E. Review the piping stress analysis to determine the design loading conditions of this location, the pipe support orientations, locations and the relative stiffness of the piping system. Some examples are:

- Is this location designed to take water hammer loads or other transient loads and did one occur?
- Is this location subject to pipe vibration?
- Is this location required for seismic or is it only required for operational transient loads?

F. Review the piping stress analyses to determine if there are other snubbers subject to the same failure mode. An example is, if a snubber failure occurred on the "A" loop is there a similar location on the "B" loop?

G. Check the environmental data for the snubber location:

- Harsh or mild environment
- Temperature range
- Radiation dose
- Humidity

3.0 External Snubber Evaluation for All Size PSA Snubbers:

In almost every case, the evaluation performed on the exterior of the snubber can give clues to the nature of the failure. Following are some things which should be looked at and evaluated during the snubber evaluation.

A. Record the following data:

- Snubber size
- Snubber serial number
- Year of manufacture
- Manufacturer's part number
- Evaluation date

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3.0 External Snubber Evaluation for All Size PSA Snubbers: (Continued)

B. Check the condition of the spherical bearing on both ends of the snubber:

Note: A bound or "frozen" spherical bearing can put unanalyzed forces into the snubber during thermal movements, causing internal stress or damage.

- Can they be moved by hand?
- Do they "squeak" when they are moved?
- Is there foreign material on the bearings?
- Are they rusty?
- Are the spherical bearings staked in place?
- Any signs of deformation?

C. Is there any physical damage to the snubbers' externals:
- Ding marks on exterior surfaces
- Welding arc marks on exterior surfaces

D. Are there any foreign materials on the exterior of the snubber? If so, would they interfere with the operation of the snubber?
- Duct tape
- Insulation materials
- Corrosion products
- Dirt or debris
- Paint or other coatings

E. Check the external surfaces of the snubber for any signs of discoloration due to excessive temperatures.

F. Fully extend the snubber, if possible, and denote any wear or other types of marks are found. The location and measurement (length, width and direction) of these marks and the actual snubber orientation during operation can be a vital clue as to what was happening to the snubber during operation.

One important aspect is to determine exactly what the snubber settings were prior to the failure and what the snubber settings were at the time of the failure. Some utilities perform snubber measurements from a fixed point on the snubber.

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3.0 <u>External Snubber Evaluation for All Size PSA Snubbers:</u> (Continued)

These measurements are recorded during the visual examinations, as well as, being documented in the Work Orders (WO) that remove the snubber from the piping system. These measurements are usually documented to the nearest 1/32nd of an inch. The importance of these measurements is that the evaluator can measure any wear marks found on the snubber and correlate the location and lengths of these wear marks to the actual snubber settings. This information can aid the evaluator in determining if these wear marks are due to the normal snubber movements (cold or hot setting) or due to vibration in either the hot or cold position.

G. Check the retainer ring at the housing to ensure that it was installed correctly (flat side down).

H. Check the connection of the transition tube kit or the forward bracket to the snubber.

- Is the tie wire intact?
- Has the transition tube loosened from the backing plate?

I. Slowly stroke the snubber by hand, if possible.

- Orient the snubber, as best as possible, to the orientation that the snubber was in the field prior to stroking.
- Record any rough spots and the location (stroke location).
- Record any noises heard.
- Did the snubber stroke under its own weight or was force needed to be applied to stroke the snubber? Was the applied force excessive?
- Did the snubber "stick" at any point in the stroke?
- Did any rough spots in the stroke correspond to any mark locations?

J. Match mark the transition tube kit or forward bracket to the snubber body and remove the transition tube kit or forward bracket.

Throughout the disassembly process, all parts should be checked for any signs of contamination, damage or wear.

4.0 Internal Snubber Evaluation for All Size PSA Snubbers:

Contamination has most notably been caused by wear products due to internal friction between the parts. A very fine reddish brown colored substance found on the internal parts may be due to fretting corrosion due to a vibration concern. This reddish brown colored substance has the consistency of a fine dust and is usually found throughout the snubber during disassembly. This substance can contaminate the lubricant causing it to dry out or become sticky.

The following are areas of notable wear, all contacting surfaces should be examined thoroughly:

- The inner tube rubbing against the outer tube on the PSA-1/4 and -1/2. The position indicating tube and the support cylinder on the PSA-1, -3, and -10.
- The brass bearing of the rod and bearing assembly rubbing against the inside surface of the Inner Tube on the PSA-1/4 and -1/2.
- All faces and surfaces of the capstan spring and keeper rings on all size snubbers.
- The rods of the rod and bearing assembly rubbing against the “ears” of the guide plate on PSA-1/4 and -1/2.
- Telescoping cylinder against the support cylinder on PSA-1, -3 and -10.
- Inertia mass rubbing against the housing on all sizes.

Other forms of contamination (i.e., dirt, debris, broken parts and corrosion particles) have also been seen frequently during disassembly. The location, amount and form of contamination should be noted throughout the disassembly process.

During disassembly the lubricant should be checked in all accessible areas:

It is suggested that “surgeons” gloves be worn during disassembly. Parts (i.e., the shaft of the torque carrier and shaft assembly) can be rolled on the gloves so the tracks of the lubricant can be seen.

- Is the lubricant moist?
- Is the lubricant dried out and/or contaminated?
- Does the lubricant “track” when the part is rolled over something?
- Check the color of the lubricant. Is it reddish brown? Is it reddish black? Is it black?
- Feel the lubricant. Does it still have its lubricating properties? Is it dried out? Does it feel gritty like it is contaminated?
- Is the amount of lubricant excessive?

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4.0 Internal Snubber Evaluation for All Size PSA Snubbers: (Continued)

Prior to disassembling the PSA-1/4 and -1/2 snubber, hold the snubber in a horizontal position up next to your ear and shake the snubber back and forth. A slight "clicking" noise should be heard indicating the snubber internals have some "free play".

- If no sound is heard, the snubber internals may be bound or the pivot bearing may not have been torqued properly (too tight).
- If excessive noise is heard, the pivot bearing may not have been torqued properly (too loose).

Slowly stroke the snubber by pulling straight up on the end plug. With the snubber stroked fully in the tension direction, slide the outer tube up to the end plug.

- Does the outer tube align with the end plug? If not, are the rods of the rod and bearing assembly bent?
- Are the rods of the rod and bearing assembly twisted?
- Twisted rods are normally an indication of mishandling during installation.
- Are the rods of the rod and bearing assembly bowed?
- Rods that are "bowed" outward or inward are usually a sign of a compressive overload.
- Does the outer tube slide easily over the inner tube?
- The outer tube should slide easily over the inner tube with little to no resistance. If not, is there foreign material, corrosion or debris between the inner and outer tubes?

Look at the internals of the snubber down through the inner tube. Is there any contamination or degradation?

- Is the pivot bearing intact?
- PSA put a small dab of white paint on the jam nut of the pivot bearing to mark the fact that the jam nut was torqued. Excessive amounts of this white paint have been found in snubbers. This white paint has been found on the rods of the rod and bearing assembly. When this paint comes in contact with the guide plate it will cause the drag loads to increase up to the point of stalling the test bench.
- Is the anti-rotation key intact?
- Is the guide plate retaining ring intact?

Slowly compress the snubber to its fully retracted position.

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4.1 PSA-1/4 and -1/2 Snubber Housing and Insert Assembly Evaluation

Removing the housing and insert assembly:

Stand the unit vertically on the housing and insert assembly and remove the retaining ring holding the outer tube to the housing and insert assembly.

Keep a gentle pressure on the snubber and turn the snubber upside down so the housing and insert assembly is pointing upwards. Slowly lift the housing and insert assembly from the snubber.

- Care should be taken not to lose the ball from the housing and insert assembly. The ball usually sticks in the insert assembly or to the end of the shaft.
- Did the ball stick to the end of the shaft or did it stick in the insert area of the housing and insert assembly?
- Inspect the lubricant on the ball.
- Clean and inspect the ball. Use a magnifying glass.
- Inspect the inside of the housing and insert assembly.
- Is there any lubricant in the insert area of the housing and insert assembly.
- Clean the housing and insert assembly and use a magnifying glass to inspect the insert area for damage or contamination.

4.2 PSA-1/4 and -1/2 Snubber Inertia Mass Evaluation:

Prior to removing or touching the inertia mass perform the following:

- Inspect the outsides for any contamination or damage. If there are wear marks on the outside surface, check the inside of the housing and insert assembly for a corresponding wear mark. Was the inertia mass hitting the inside of the housing?
- Check the tip of the shaft to see if it is bent, nicked or "mushroomed".
- Check the washers. Are they shiny from wear? Are they bent?
- Check the lubricant at the hole area of the inertia mass. Is it contaminated?
- Check that the capstan spring tangs are captured in the opened area of the clutch spring.
- Check for deformed or damaged washers on the shaft.
- Can the washers be easily removed?

Remove and inspect the washers.

- Damaged washers could be a sign of a snubber overload.

4.2 PSA-1/4 and -1/2 Snubber Inertia Mass Evaluation: (Continued)

Remove the inertia mass and perform the following:

- Note whether the inertia mass came off the shaft easily or if force had to be used to remove it from the shaft.
- Inspect the inside surfaces of the inertia mass.
- Note any contamination or damage.

4.3 PSA-1/4 and -1/2 Snubber Clutch Spring Evaluation:

Prior to removing the clutch spring, inspect it to ensure that it was installed properly (fully seated in the inertia mass).

- A disengaged clutch spring can cause the snubbers acceleration test to be unacceptable if one or both of the capstan spring tangs are not captured.

Remove and inspect the clutch spring.

- Are there any marks or indentations on the clutch spring where the capstan spring tangs had contacted it?
- Are there any signs of contamination?

4.4 PSA-1/4 and -1/2 Snubber Torque Carrier and Shaft Assembly Evaluation:

Before removing the torque carrier and shaft assembly, check the lubricant on the tip of the compression side of the shaft.

- Slowly remove and then inspect the torque carrier and shaft assembly.
- Check the lubricant on the shaft.
- Inspect the compression and tension side ends of the shaft.
- The ends of the shaft of the torque carrier and shaft assembly are "cupped". It is very important to inspect these ends for wear or damage. Use a magnifying glass. Damaged ends of the shaft could cause the shaft to bind in the insert area of the housing and insert assembly or in the pivot bearing. If the cupped ends are "mushroomed", the shaft may have been subjected to an overload.
- Check the run-outs on the shaft in three places: At the torque carrier, at mid span and at the tension side end.

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4.5 PSA-1/4 and -1/2 Snubber Capstan Spring Evaluation:

Prior to removing the capstan spring, mark it so you can tell which side was toward the tension side of the shaft. A "Sharpie" marker works good. Draw an arrow on the capstan spring pointing to the tension side of the shaft.

- Wear on the capstan spring tangs and the faces of the capstan spring, that contact the keeper rings, can give evidence of a normal operating snubber or one that has been subjected to piping vibration.
- Check that the keeper rings are installed properly. Improper installation of the keeper rings could cause the capstan spring to be "cocked". This could lead to the capstan spring binding on the capstan area of the inner tube. This would lead to high drag loads during the functional test.

- Remove the outer keeper ring and remove the capstan spring. Ensure that you know what side of the keeper was contacting the capstan spring.

- Inspect the outside surface, the inside surface, the faces that contact the keeper rings and especially the "tang" areas of the capstan spring for wear or damage.
- Note excessive wear on the capstan spring surfaces, especially at the "tang" areas. Wear in these areas may be an indication of a piping vibration concern.
- Is the inside "running" surface of the capstan spring greasy or dry?

4.6 PSA-1/4 and -1/2 Snubber Rod and Bearing Assembly Evaluation:

Rotate the rod and bearing assembly to disengage the anti-rotation key and remove the anti-rotation key.

Remove the retaining ring that holds the rod and bearing assembly to the inside of the inner tube and remove the rod and bearing assembly.

- Inspect the rod and bearing assembly for any signs of contamination or degradation.
- Take run-outs on the rod and bearing assembly.

4.7 PSA-1/4 and -1/2 Snubber Inner and Outer Tube Evaluation:

Inspect the internals of the inner tube and outer tube for any signs of contamination or degradation.

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4.8 PSA-1/4 and -1/2 Snubber Pivot Bearing, Jam Nut and Lock Washer Evaluation:

Remove and inspect the pivot bearing, jam nut and lock washer. Note any areas of excessive wear, contamination or any damaged parts.

5.0 PSA-1, -3, -10, -35 and -100 Position Indicator Tube, Filister Head Screws and Flat Washers Evaluation:

Remove the Filister head screws, flat washers and position indicator tube.

- Check the inside surface of the Indicator tube for contamination and wear markings and debris.
- Check the Filister head screws for damaged threads.

5.1 PSA-1, -3, -10, -35 and -100 Housing Evaluation:

Removing the housing from the snubber internals:

Stand unit up vertically on the housing and remove the retaining ring holding the outer tube to the housing.

- Inspect the retaining ring.

Keep gentle pressure on the housing while lifting the snubber with its internals from the housing.

- Inspect the inside of the housing.
- Is there any contamination or degradation? Look for internal rust, corrosion, loose debris and broken parts. Are there signs of wear due to the inertia mass contacting the housing?
- Check the dust cover for signs of impingement. Indent marks on the center of the dust cover are a sign that the shaft impacted the dust cover. This is a sign of overload.

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5.2 PSA-1, -3, -10, -35 and -100 Inertia Mass Evaluation:

Prior to removing or touching the inertia mass perform the following:

- Inspect the outsides for any contamination or damage. If there are wear marks on the outside surface, check the inside of the housing and insert assembly for a corresponding wear mark. Was the inertia mass hitting the inside of the housing?
- Check the tip of the shaft to see if it is bent, nicked or "mushroomed".
- Check the washers. Are they shiny from wear? Are they bent?
- Check the lubricant at the hole area of the inertia mass. Is it contaminated?
- Check that the capstan spring tangs are captured in the opened area of the clutch spring.
- Check for deformed or damaged washers on the shaft.
- Can the washers be easily removed?

Remove and inspect the washers.

- Damaged washers could be a sign of a snubber overload.

Remove the inertia mass and perform the following:

- Note whether the inertia mass came off the shaft easily or if force had to be used to remove it from the shaft.
- Inspect the inside surfaces of the inertia mass.
- Note any contamination or damage.

5.3 PSA-1, -3, -10, -35 and -100 Clutch Spring Evaluation:

Prior to removing the clutch spring, inspect it to ensure that it was installed properly (fully seated in the inertia mass).

- A disengaged clutch spring can cause the snubbers acceleration test to be unacceptable if one or both of the capstan spring tangs are not captured.

Remove and inspect the clutch spring.

- Are there any marks or indentations on the clutch spring where the capstan spring tangs had contacted it?
- Are there any signs of contamination?

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5.4 PSA-1, -3, -10, -35 and -100 Torque Drum (Carrier) Evaluation:

Prior to removing the torque drum (carrier), inspect the outside surfaces for contamination or degradation.

Inspect the flat washers and retaining ring for signs of contamination or degradation.

Remove the flat washers, retaining ring and torque drum and perform the following:

- Note whether the torque drum (carrier) came off the shaft easily or if force had to be used to remove it from the shaft.
- Inspect the inside surfaces of the torque drum (carrier).
- Note any contamination or damage.
- Check the washers. Are they shiny from wear? Are they bent?
- Check the lubricant at the hole area of the torque drum. Is it contaminated or dried out?
- Check for deformed or damaged washers.
- Can the washers be easily removed?
- Remove and inspect the retaining ring and washers from the ball screw and shaft.
- Check the lubrication on all removed parts.
- Check lubricant on the washers.
- Are the washers damaged? Damaged washers could be a sign of an overload.

5.5 PSA-1, -3, -10, -35 and -100 Capstan Spring Evaluation:

Prior to removing the capstan spring, mark it so you can tell which side was toward the tension side of the shaft. A "Sharpie" marker works good. Draw an arrow on the capstan spring pointing to the tension side of the shaft.

- Wear on the capstan spring tangs and the faces of the capstan spring, that contact the keeper rings, can give evidence of a normal operating snubber or one that has been subjected to piping vibration.

Check that the keeper rings are installed properly. Improper installation of the keeper rings could cause the capstan spring to be "cocked". This could lead to the capstan spring binding on the capstan area of the inner tube. This would lead to high drag loads during the functional test.

5.5 **PSA-1, -3, -10, -35 and -100 Capstan Spring Evaluation: (Continued)**

- Remove the outer keeper ring and remove the capstan spring. Ensure that you know what side of the keeper was contacting the capstan spring.
- Inspect the outside surface, the inside surface, the faces that contact the keeper rings and especially the "tang" areas of the capstan spring for wear or damage.
- Note excessive wear on the capstan spring surfaces, especially at the "tang" areas. Wear in these areas may be an indication of a piping vibration concern.
- Is the inside "running" surface of the capstan spring greasy or dry?

5.6 **PSA-1, -3, and -10 Bearing Nut Evaluation:**

- Remove and inspect the bearing nut. Note any signs of contamination or degradation.
- Denote the condition of the lubricant on the bearing nut threads.

5.7 **PSA-1, -3, -10, -35 and -100 Thrust Bearing Evaluation:**

Prior to removing the thrust bearing, match mark the outer and inner races. It is important to note that the outer race is the compression side outer race.

Remove the thrust bearing.

- Document any wear marks found on the races. Radial "cat's eyes" markings are a sign of vibration.
- Marks that appear to be small evenly spaced dots are a sign of possible overload.

Check the lubricant on all of the parts.

Inspect the bearing balls for the following:

- Were they installed properly?
- Were there any signs of contamination or degradation?
- What is the condition of the lubricant?

5.8 **PSA-1, -3, -10, -35 and -100 End Plug Evaluation:**

Remove and inspect the end plug for any signs of contamination or degradation. Oil that has separated from the lubricant has been found in the end plug. If oil I

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5.9 PSA-1, -3, -10, -35 and -100 Ball (Recirculating Ball) Screw and Shaft (Precision Leadscrew) Assembly Evaluation:

- Remove and inspect the ball (recirculating ball) screw and shaft (precision leadscrew) assembly.
- Check the lubricant on the shaft.
- Does the bearing assembly run up and down the shaft under its own weight?
- Does the bearing assembly run up and down the shaft under its own weight after the lubricant has been removed or redistributed?
- Check the shaft (precision leadscrew) threads for signs of vibration or overload.

5.10 PSA-1, -3, -10, -35 and -100 Telescoping Cylinder Evaluation:

- Remove and inspect the telescoping cylinder for any signs of contamination or degradation.
- Note the location of all areas of wear. Snubbers that are installed horizontally usually have some amount of wear due to the telescoping cylinder rubbing against the support cylinder.

5.11 PSA-1, -3, -10, -35 and -100 Support Cylinder Evaluation:

- Check all surfaces of the support cylinder for indications of wear, contamination or degradation.

5.12 PSA-35 and -100 Planetary and Ring Gear Evaluation:

- Check gears for any dents, burrs or defects on the teeth.

5.13 PSA-35 and -100 Washer Plate Evaluation:

- Check the washers. Are they shiny from wear? Are they bent?
- Check for deformed or damaged washers.
- Can the washers be easily removed?

Remove and inspect the washers.

- A damaged washer could be a sign of a snubber overload.

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MECHANICAL SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

MECHANICAL SNUBBERS		
FAILURE MODE	**INDICATIONS**	**FAILURE CAUSE**
HIGH DRAG	BENT SCREW SHAFT	OVER LOAD OR TRANSIENT
	INERTIA MASS TOUCHING DUST COVER	OVER LOAD OR TRANSIENT
	FOREIGN MATERIAL ON SCREW SHAFT	ENVIRONMENT
	FOREIGN MATERIAL ON INDICATOR TUBE	ENVIRONMENT
	CRACKED THRUST BEARING	OVER LOAD OR TRANSIENT
	DRY LUBRICANT	ENVIRONMENT
	CORROSION OF TORQUE DRUM	ENVIRONMENT
	CORROSION OF CAPSTAN SPRING	ENVIRONMENT
	ROUGH SPOTS ON PLANETARY GEARS	MAINTENANCE
	THRUST BEARING FRETTING	OVER LOAD OR TRANSIENT
	CAPSTAN SPRING WOUND TO TIGHT	MANUFACTURE
	BINDING OF TELESCOPING MEMBERS	OVER LOAD OR TRANSIENT
	LOOSE BEARING RETAINER NUT	MANUFACTURE
	TELESCOPIC MEMBERS NOT CONCENTRIC	MANUFACTURE
	WELD SPATTER ON INDICATOR TUBE	MAINTENANCE
	BENT GUIDE RODS	OVER LOAD OR TRANSIENT
	FLAKED PLATING ON MOVING PARTS	MANUFACTURE
	BROKEN TEETH	OVER LOAD OR TRANSIENT
	FLATTENED BALLS	OVER LOAD OR TRANSIENT
	MISMATCHED BALLS AND BALL NUT	MANUFACTURE
	UNKNOWN	UNKNOWN

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HYDRAULIC AND MECHANICAL SNUBBER FAILURE MODES, INDICATIONS AND FAILURE CAUSE

MECHANICAL SNUBBERS		
FAILURE MODE	**INDICATIONS**	**FAILURE CAUSE**
ACCELERATION OR HIGH VELOCITY	CAPSTAN SPRING TOO LOOSE	MANUFACTURE
	CAPSTAN SPRING NOT INSTALLED PROPERLY	MANUFACTURE
	WORN CAPSTAN SPRING	OVER LOAD OR TRANSIENT
	KEEPER RING NOT INSTALLED CORRECTLY	MANUFACTURE
	EXCESSIVE LUBRICANT ON TORQUE DRUM	MANUFACTURE
	LUBRICANT ON INERTIA MASS	MANUFACTURE
	BENT CLUTCH TANG	MANUFACTURE
	FRACTURED BALL SCREW SHAFT	OVER LOAD OR TRANSIENT
	LOCKED DUE TO CORROSION	ENVIRONMENT
	LOCKED DUE TO INTERNAL DAMAGE	ENVIRONMENT
	BROKEN FREE	ENVIRONMENT

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SNUBBER REQUEST FOR RELIEF

This relief request was approved by the NRC per Reference N and will be implemented during the Unit 2 Cycle 12 refueling outage.

SUMMARY:

Pursuant to 10CFR50.55a(g)(6)(i), (a)(3)(i) or (a)(3)(ii), TVA is requesting relief from the identified ASME Section XI requirements related to examination and testing of snubbers. TVA proposes to continue use of the examination and testing plans currently defined in the Technical Requirements Manual (TR 3.7.4). The current Technical Requirements Manual requirements have been promulgated, accepted, and approved (on July 14, 1998, for Browns Ferry Plant, Units 1, 2, and 3) by NRC, while ASME Section XI imposes overlapping requirements which do not enhance the quality and safety of the subject snubber examination and testing.

COMPONENTS:

Component/piping snubbers

CODE CLASS:

1, 2 and 3

CODE REQUIREMENT:

1995 Edition of ASME Section XI Code, 1996 Addenda

IWF-5300(a), (b), and (c) inservice examination and testing shall be performed in accordance with ASME/ANSI O & M, Part 4, using VT-3 visual examination method in IWA-2213.

IWF-5400 Repair/Replacement activities performed on snubbers shall be in accordance with IWA-4000. Snubbers installed, corrected, or modified by repair/replacement activities shall be examined and tested in accordance with the applicable requirements of IWF-5200 prior to return to service.

IWA-6230 requires inservice inspection summary reports for snubbers be filed with regulatory authority.

IWA-2110 requires Authorized Nuclear Inservice Inspector (ANII) involvement for snubber examination and testing.

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CODE REQUIREMENT FROM WHICH RELIEF IS REQUESTED:

In accordance with 10CFR50.55a(g)(6)(i), (a)(3)(i) or (a)(3)(ii) relief is requested from the ASME Section XI, Code, 1995 Edition, 1996 Addenda, Article IWF-5000 which provides, among other things, inservice inspection requirements, repair/replacement activities performed on snubbers, and the ASME/ANSI O & M, Part 4 for examinations and tests performed on snubbers:

a) IWF-5300(a), (b), and (c) Inservice Examinations and Tests, ASME/ANSI O & M, Part 4, using VT-3 visual exam method describe in IWA-2213.

b) IWF-5400 Repairs/Replacements of snubbers shall be in accordance with IWA-4000. Repaired or Replacement snubbers examined and tested in accordance with the requirements of IWF-5200 prior to return to service..

c) IWA-6230, Summary Report Preparation (for snubbers).

d) IWA-2110(a)(5) and (c), Duties of the Inspector (involvement on snubber Examination and Inspection).

BASIS FOR RELIEF:

ASME Section XI Code, Class 1, 2, and 3 equivalent snubbers are examined and tested in accordance with Browns Ferry Nuclear (BFN) Plant Technical Requirements Manual (TRM), TR 3.7.4. BFN TR 3.7.4 is prepared in accordance with the guidance given by NRC in Generic Letter 90-09. The scope for snubbers examined and tested in accordance with TR 3.7.4 is not limited by line size or other applicable code exemptions and includes a numerically greater population of snubbers than the Section XI program. Examination and testing of the snubbers in accordance with both ASME Section XI and the plant TRM would result in duplication of effort utilizing different standards and require the preparation of a separate program and associated procedures. This would result in additional cost and unnecessary radiological exposure. In addition the personnel performing snubber visual examinations would also be required to be certified in accordance with the American Society of Nondestructive Testing (ASNT) SNT-TC-1A " Personnel Qualification and Certification in Nondestructive Testing", which is an additional certification as compared to the task training qualification required to perform the TRM required examinations and testing of snubbers. The existing TRM program for examination and testing of snubbers was promulgated, accepted, and approved by NRC.

BASIS FOR RELIEF: (Continued)

The implementation of ASME/ANSI O & M, Part 4, would require BFN to initiate a snubber examination and testing program that is more complicated and expensive to perform, without a compensating increase in the level of quality and safety.

ALTERNATE EXAMINATIONS:

The BFN TRM, TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities. The procedures utilized for these examinations are: 2-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers"; 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers"; 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson Hydraulic Snubbers"; 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints"; 0-SI-4.6.H-2D, "Functional Testing of Grinnell Hydraulic Snubbers"; 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers"; MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Paterson Unit Disassembly and Reassembly"; and MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Torus Dynamic Restraints Snubbers". This will include the pin-to-pin area inclusive of applicable snubbers.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with MPI-0-000-SNB004, "Instructions for Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson Hydraulic, Grinnell Hydraulic, and Bergen-Paterson or Lisega Large Bore Torus Dynamic Restraints Snubbers".

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the site corrective action program, SSP-3.1, and the implementing procedures (2-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D, 0-SI-4.6.H-2E, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported will remain in the ASME Section XI examination boundary.

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JUSTIFICATION FOR THE GRANTING OF RELIEF:

The current program, as defined by TR 3.7.4, provides for a level of quality and safety equal to or greater than that provided by ASME Section XI Code, 1995 Edition, 1996 Addenda and requirements defined in ASME/ANSI O & M, Part 4, and utilizes NRC guidance not incorporated in the O & M Code referenced by the 1995 Edition. IWF-5300(a) covers the snubber visual inspection requirements and IWF-5300(b) covers the snubber functional test requirements..

Examination, testing, repair and replacement of snubbers is currently performed in accordance with TR 3.7.4, which utilizes the guidance provided by NRC in Generic Letter 90-09. The O & M Code referenced by ASME Section XI has a different basis for examination (failure mode groups) and test plans (10%, 37, or 55). It is impractical to implement both plans because of the resulting duplication of examination and testing efforts and different requirements for snubber quantities subject to examination or test, actually examined and/or tested, and sample expansion requirements. This would result in additional cost and unnecessary radiological exposure. The existing TRM program for examination and testing of snubbers has been promulgated and accepted by NRC. The differences in the two programs could create confusion when selecting test samples, applying acceptance criteria, corrective actions and examination schedules for failed snubbers. This situation could increase the possibility of applying the wrong action, thus creating a nonconformance, an in-operability or even a violation of a TRM requirement.

To eliminate any misinterpretation or confusion in administering overlapping requirements for snubbers, and to remove the possibility of applying contradicting requirements to the same snubber(s), BFN proposes to examine and test snubbers in accordance with BFN TR 3.7.4.

Sub-article IWF-5400 provides the requirements for repair/replacement activities performed on snubbers to be in accordance with IWA-4000. Snubbers installed, corrected, or modified by repair/replacement activities examined and tested in accordance with the applicable requirements of IWF-5200 prior to return to service. TR 3.7.4 (TSR 3.7.4.6) requires replacement snubbers and snubbers with repairs which might affect the functional test results be tested to meet the functional test criteria prior to installation.

Maintenance procedure MPI-0-000-SNB004 and provides pre-service inspection procedure for ASME Section XI repair/replacement and for removal/installation of snubbers at BFN.

JUSTIFICATION FOR THE GRANTING OF RELIEF: (Continued)

ASME Section XI, VT-3 certification required for personnel performing snubber visual examinations is an additional certification as compared with the TRM program training qualifications. Personnel performing the TRM required visual examinations are "process qualified" to perform the examinations and testing required by the TRM and implemented by the referenced procedures. This training currently includes a visual test associated with face mask fit and specific training on the acceptance criteria associated with procedure MPI-0-000-SNB004. Additional "visual acuity" verification for personnel performing snubber visual examinations will include visual acuity requirements that meet ASME Section XI. The training and documentation of personnel to the visual acceptance criteria, specified in the TRM implementing procedures, provides an acceptable level of quality and safety.

Since relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to require ANII involvement. The BFN TRM snubber program does not require the use of an ANII for examination and test requirements. The ANII will not be involved in the TRM required visual examination or testing activities performed in lieu of the ASME Code requirements. A snubber program manager provides oversight of the TRM snubber program implementation for both visual and functional testing. This oversight includes both review and evaluation of visual examination and functional testing data to ensure TRM requirements are met. The snubber program manager provides an acceptable level of quality and safety without ANII involvement in those activities. ANII involvement in other inservice repair and replacement snubber activities, as required by IWA-2110(g) and (h) and implemented by BFN's ASME Section XI repair and replacement program will be maintained.

ASME XI, 1995 Edition, 1996 Addenda, Sub-article IWA-6230 provides the requirements in the preparation of summary report documenting the preservice and inservice inspections, and ASME OMa Code, Part 4, Sections 2.2 and 3.3 provides necessary documentation to verify the results of preservice and inservice examination and testing programs for snubbers. Under the alternate requirements for snubbers, there will be no ASME Section XI preservice and inservice examination and testing to document in a summary report. TR 3.7.4 is implemented by surveillance instructions 3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2D, 0-SI-4.6.H-2E, and maintenance instruction MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program, include data sheets for documenting the visual examination, functional test data, and results, and provides documentation and evaluation of non conforming results. The completed data sheets are QA records and are controlled and maintained in accordance with the BFN QA records program. These records are available onsite for review and inspection.

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JUSTIFICATION FOR THE GRANTING OF RELIEF: (Continued)

The QA records documenting snubber visual examinations and functional tests results provides an acceptable level of quality and safety when compared to the requirements of ASME Section XI and ASME OM Code-1995 Edition, 1996 Addenda, Part 4.

Based on the justification provided, BFN's examination and testing of snubbers, in accordance with TR 3.7.4 will provide an acceptable level of quality and safety. Therefore, pursuant to 10CFR50.55a(g)(6)(i), (a)(3)(i) or (a)(3)(ii), TVA request that relief be granted from the 1995 Edition of ASME Section XI Code requirements related to inservice examination and testing for snubbers.

IMPLEMENTATION SCHEDULE:

TR 3.7.4 will be implemented during the third ten-year ASME Section XI inspection interval for snubber examination and testing in lieu of the code requirements listed above.

Attachment H

BFN MECHANICAL PREVENTIVE INSTRUCTION

MPI-0-000-SNB002,

Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling and Fronek Unit Disassembly and Reassembly

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

MECHANICAL PREVENTIVE INSTRUCTION

MPI-0-000-SNB002

HYDRAULIC SHOCK AND SWAY ARRESTOR BERGEN-PATTERSON ANCHOR/DARLING AND FRONEK UNIT DISASSEMBLY AND REASSEMBLY

REVISION 16

PREPARED BY: R. WEBB PHONE: 3127

RESPONSIBLE ORGANIZATION: MECHANICAL MAINTENANCE

APPROVED BY: WILLIAM M. HILL DATE: 02/01/2005

EFFECTIVE DATE: 02/02/2005

LEVEL OF USE: REFERENCE USE

QUALITY-RELATED

REVISION LOG

Procedure Number: MPI-0-000-SNB002 Revision Number: 16

Pages Affected: 4, 22, 23

Description of Change:

IC-17- Revised to add Step 3.5 allowing steps to be marked N/A with concurrence from the Work Supervisor. Added second page to Attachment 2 for recording remarks.

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ILLUSTRATION/ATTACHMENTS

1.0 PURPOSE/SCOPE/FREQUENCY

1.1 Purpose

This instruction is to serve as a guide in the rebuilding of Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Shock and Sway Arrestors.

1.2 Scope

This instruction will ensure the disassembly, and reassembly of the Bergen-Paterson, Anchor/Darling and Fronek Hydraulic Shock and Sway Arrestors is performed properly.

It covers both Preventive and Corrective Maintenance Practices, which will ensure the shock and sway arrestors remain operable and perform their intended function.

The Bergen-Paterson line of snubbers have been acquired by Anchor/Darling Industries, Inc. and now Anchor/Darling has been acquired by Fronek. Instructions in this procedure for Bergen-Paterson snubbers addressed as HSSA-XXX etc. are also applicable to the corresponding Anchor/Darling and Fronek snubber numbers ADH-XXX etc. identified by the same rated load.

1.3 Frequency

[PER/C] Frequencies are established and maintained in accordance with the plant Preventive Maintenance (PM) Program and Qualification Maintenance Data Sheets (QMDS), as applicable, or as required for maintenance. [PER BFPER940037]

2.0 REFERENCES

MPI-0-000-SNB002, Functional Testing and Corrective Adjustments to Bergen-Paterson Hydraulic Shock Arrestors.

MSI-0-000-PRO017, General Torquing Guide.

BFN-VTM-B209-0230 (BFN-VTD-B209-0240), Installation Instructions for Hydraulic Shock and Sway Arrestors.

BFN-VTM-B209-0230 (BFN-VTD-B209-0250), Hydraulic Shock and Sway Arrestor Technical Maintenance Manual with Spare Parts Listings.

[PER/C] PM Program Establishes Frequencies. [PER BFPER940037]

BFPER960004, Pre Service Inspections

0-TI-397, Performance of Maintenance Inspections and Verifications.

3.0 PRECAUTIONS/LIMITATIONS/ALARA

3.1 Care should be taken when disassembling the reservoir due to high pressure.

3.2 ALARA - None.

3.3 [PER/C] Parts identified with an asterisk on Attachments 9B & 10C are considered to fall within the scope of the ASME Section XI repair and replacement program. If these parts are required to be replaced, the work package shall be returned to planning to add the applicable ASME Section XI requirements for ANI/ANII review. No further work may progress until the Section XI paperwork has been approved by the ANI/ANII [BFPER 00- 003241-000]

3.4 The steps in this instruction may be performed out of sequence to best facilitate the flow of work provided: no prerequisites are violated, completion of subsequent steps are not impaired, and all required inspections and verifications are completed.

3.5 The steps in this instruction may be marked N/A (Not Applicable) with prior concurrence from the Work Supervisor. Concurrence must be documented in the Remarks Section of Attachment 2.

4.0 PREREQUISITES

4.1 VERIFY that all required replacement parts are on hand prior to performing any maintenance on the snubber(s).

4.2 VERIFY all required tools are on hand as listed.

5.0 RECOMMENDED EQUIPMENT

Sockets - 1/2" drive (set) , Open/box wrenches (set).

Adapter socket 1/2" to 3/8" drive, 12 pt. 1/4" socket for 3/8" drive.

Allen Wrenches (set).

Adjustable wrench (8" or 12").

Torque wrench (6 ft-lb min. 300 ft-lb max.).

Screwdriver (1/4 or 1/8 blade).

O-ring picks.

Fluid gun, Cutting knife.

Cleaning fluid.

Silicone fluid (SF-1154).

5/16-18 NC threaded rod (8" long) with washer and nut.

6.0 ACCEPTANCE REQUIREMENTS

6.1 Snubber shall have no leaks.

6.2 Rebuilt snubber(s) shall pass functional test criteria in 0-SI-4.6.H-2B.

7.0 INSTRUCTIONS STEPS

Basic Design and Technical Information

The unit comprises an externally ported hydraulic cylinder with a flow control valve and filled fluid accumulator. In operation, the piston is free to move unrestricted in either direction, for all piston velocities up to 10 inches per minute, after which the piston will lock and the unit will act as a rigid strut. This velocity is greater than any operation thermal growth and less than the velocity of any normally anticipated disturbing force.

Therefore, if the unit is checked initially, or when adjustment of the piston stroke is required, care should be taken to avoid sudden force and only a gradual force should be used; otherwise, the piston rod will lock. This will occur in both tension and compression.

If this occurs, reversal of the force will unlock the piston rod again, using a gradual force.

The spring-loaded accumulator, which makes it possible to install the unit at any angle or position, is of sufficient capacity to serve also as a fluid reservoir. Fluid level is indicated by a round plunger (1) extending out through the accumulator housing (2) (Attachment 3).

It is recommended that the stroke reserve not be less than one inch in either direction as indicated by the accumulator plunger (1) (Attachment 3).

The piston rod should be set at the piston rod extension (Attachment 4) dimension as specified on (Attachment 4) of MPI-0-000-SNB004. The piston rod position is measured from the point of rod (3) emergence from the unit head (1) to the small hole (2) in one of the wrench flats (4) (Attachment 4).

A change in piston rod setting is obtained by either pushing or pulling on the rod, as required. Force must be applied slowly in order not to cause closure of the control valve poppet.

7.0 INSTRUCTIONS STEPS (Continued)

Precaution should be taken NOT to use pipe wrenches on the polished surface of the piston rod (3) (Attachment 4). The wrench flats (4) are provided near the threaded end of the rod (3) (Attachment 4) for this purpose using either open end or box end wrenches.

This procedure can be used to correct unacceptable piston rod surface conditions with the approval of the Snubber Engineer/Designee. If after a visual inspection it is determined that the piston rod (3) (Attachment 4) shows signs of minor scoring or has foreign matter adhering to it (i.e., paint, dirt, corrosion), these areas may be lightly polished with a fine grit Emory cloth/paper or hand buffed with a scotchbrite pad.

Proper level is indicated with the end of accumulator plunger (1) (Attachment 3) at or near the "EXT" mark with the piston rod (3) (Attachment 4) fully extended or with the plunger (1) (Attachment 3) end at or near the "RET" mark with the piston rod (3) (Attachment 4) fully retracted. If the accumulator plunger (1) (Attachment 3) is below the "EXT" indication, or one graduation below "RET", then fluid should be added.

The fluid level scale (3) (Attachment 3) has six divisions, each representing one inch of piston movement for the 6-inch stroke unit. Likewise, for the 12-inch stroke unit, the fluid level scale is divided into 12 divisions, each representing one inch of piston movement.

To determine exact proper fill level, measure piston rod extension, (Attachment 4) subtract 3/4-inch, and count back one increment for each inch from "RET" mark towards "EXT" mark. The 3/4-inch dimension is the fixed distance from the drilled hole (2) to the point of rod (3) emergence from the unit head (1) (Attachment 4) as noted previously.

The procedure can also be used to determine rod position by visual inspection.

7.1 Unit Disassembly

NOTE:

(1) Cleanliness is the most important part of this operation. Cleanliness of parts, work place, and the person who disassembles and reassembles the unit will directly affect its performance. Some of the flow passages are extremely small and the slightest chip, piece of lint, or particle of dirt will prevent the snubber from operating properly.

(2) For removal of the old seals, the following points should be considered.

(3) O-ring removal involves working with parts that have close tolerance surface finishes. In critical surface finish areas, scratches, abrasions, dents, and surface deformities cause faulty seals resulting in functional failure of components.

(4) [PER/C] Parts identified with an asterisk on Attachments 9B & 10C are considered to fall within the scope of the ASME Section XI repair and replacement program. If these parts are required to be replaced, the work package shall be returned to planning to add the applicable ASME Section XI requirements for ANI/ANII review. [BFPER 00-003241-000]

****

CAUTION

Do not use hardened steel, pointed, or sharp-edged tools (knives, screwdrivers, keys) for removal or installation of o-rings or backup rings. Soft metal tools such as brass or aluminum are suitable, and tools of phenolic rod, plastics, or wood can be formed into useful aids to help in ring removal and installation.

Tool surfaces must be well rounded, polished, and free of burrs. Check your tools often, especially those surfaces that come in contact with ring grooves and critical polished areas.

When o-rings and backup rings are removed from pistons and cylinders, every effort should be made to avoid contact of tools with critical surfaces or parts. When removed, keep old o-rings with their respective components after removal so that they may be used for comparison to new rings.

****

7.1 Unit Disassembly (Continued)

7.1.1 Preparation Prior to Disassembly

7.1.1.1 UNSCREW piston rod (3) from threaded rod end adaptor (1) (Attachment 5).

7.1.1.2 Use open end or box end wrench on piston rod (3), rotating adapter (1) or entire unit rather than by rotating piston rod (3) (Attachment 5) to prevent scoring of inner cylinder wall by cast-iron piston rings.

NOTE: If piston rod (3) (Attachment 5) has been marred, use emery cloth/paper or scotch brite pad to remove scoring.

7.1.1.3 Upon disassembly of strut assemblies, TAG major parts and STORE bolts and related hardware with assemblies for reuse on reinstallation of unit.

7.1.1.4 CLEAN exterior of unit prior to disassembly with cleaning fluid.

7.1.1.5 To relieve the spring force and subsequent fluid pressure in the accumulator housing (1), THREAD the 5/16-18 NC rod with nut and two flat washers into the indicator rod (5) (Min. 1/2-inch) and TIGHTEN until resistance is felt on the indicator plunger (5) (Attachment 7 or 8) indicating compression of the accumulator spring (13a) (Attachment 9a) or (1) (Attachment 10a).

****

CAUTION

Caution should be taken to avoid spillage by holding unit over a collection can during the initial bleeding operation. Fluid may cause irritation upon contact with the eyes.

****

7.1.1.6 PERFORM the following to remove fluid:

7.1.1.6.1 UNBOLT the four Allen screws (6) holding accumulator (1) to main cylinder (4) (Attachment 8).

7.1.1.6.2 UNBOLT the four Allen screws (6) securing valve manifold flanges onto main cylinder (4) (Attachment 8).

7.1 Unit Disassembly (Continued)

7.1.1.6.3 DRAIN fluid into a suitable container.

OR

7.1.1.6.4 BLEED the unit by unscrewing the 1/4-inch screw (5) (Attachment 9a) or (2) (Attachment 10a) located in the back plate of the accumulator (1) (Attachment 7 or 8) next to the filler plug, (4) (Attachment 9a) or (13) (Attachment 10a) using precautions as outlined above.

7.1.1.6.5 PUSH the piston rod (3) (Attachment 7 or 8) in slowly to promote flow of fluid out of bleed hole.

7.1.1.6.6 EXTEND piston rod (3) (Attachment 7 or 8) and COMPRESS again slowly, to force fluid out of the main cylinder (4) (Attachment 7 or 8) as well.

7.1.2 Disassembly of Unit

NOTE:

Since there are two basic configurations, use the outlined procedure of the style being disassembled.

Old style - Unit has external tubing between accumulator and valve manifold (Attachment 8).

7.1.2.1 DISCONNECT 1/8-inch tubing fitting (7) (Attachment 8) and LOOSEN end near valve manifold first.

NOTE:

Care should be taken to avoid damage to the Allen screws (6) (Attachment 8) or associated parts due to the close proximity of components.

7.1.2.2 If not previously removed to facilitate fluid removal, UNBOLT the four Allen screws (6) holding accumulator (1) to main cylinder (4) (Attachment 8).

7.1.2.3 If not previously removed to facilitate fluid removal, UNBOLT the four Allen screws (6) securing valve manifold flanges onto main cylinder (4) (Attachment 8).

7.1 Unit Disassembly (Continued)

7.1.3 Disassembly of Accumulator

7.1.3.1 Using a pair of vise grips to secure the tie rod (10 or 10a), LOOSEN each of the tie rods (10 or 10a) (Attachment 9a) in sequence using open or box end wrenches.

7.1.3.2 LOOSEN these tie rods (10 or 10a) (Attachment 9a) so that the end plates (6 & 9) (Attachment 9a) will not bind.

NOTE:

(1) If the accumulator indicator rod (5) (Attachment 8) was not secured by a 5/16-inch rod, then the final stages of this loosening operation will involve compressing the end plates (6 & 9) (Attachment 9a) with one hand while removing the nuts from the tie rods (10 or 10a) (Attachment 9a) with the other. It may be found that due to the pressure exerted by the accumulator spring, (13a) (Attachment 9a) two persons should be used during this step.

(2) If the 5/16-inch rod has been used to secure the accumulator piston (14) hand compression of the end plates (6 & 9) will not be necessary, but, in this case, the bolt will have to be untightened to remove the accumulator piston (14) and accumulator spring (13a) (Attachment 9a).

7.1.3.3 DETACH the rear end plate (9).

7.1.3.4 REMOVE the accumulator spring (13a), piston (14) and front end plate (6) from accumulator cylinder (7) (Attachment 9a).

7.1.3.5 REMOVE old piston packing (15) (Attachment 9a), taking care to avoid damage to metal surfaces.

7.1.3.6 CLEAN all metal parts of the accumulator (1) (Attachment 8) and place parts on assembly bench.

7.1 Unit Disassembly (Continued)

7.1.4 Disassembly of Main Cylinder

7.1.4.1 UNBOLT and REMOVE external piston rod guide, taking care to avoid damage to the piston rod and bushing surfaces.

7.1.4.2 EXAMINE the piston rod (3) (Attachment 8) for abrasions or nicks prior to this step and REMOVE by filing or sanding to prevent damage to the gland (10) (Attachment 9b) surfaces in the guide.

7.1.4.3 Using an Allen wrench, LOOSEN the Allen nuts (1) on the back plate (1).

7.1.4.4 LOOSEN each tie rod (8) in sequence using a vise grip to hold the tie rod (8) (Attachment 8).

****

CAUTION

Caution must be taken to avoid bending of the tie rods (8) (Attachment 8), or stripping of threads during this step.

****

7.1.4.5 REMOVE o-ring seals (16) from end plates (13), wiper (14) and gland (10) (Attachment 9b) from the external piston rod guide.

7.1.4.6 CLEAN all parts and PLACE on the assembly bench, to allow them to air dry.

7.1 Unit Disassembly (Continued)

7.1.5 Disassembly of Control Valve Manifold

NOTE:

Due to the nature of this component, it should be disassembled in a cleared-off area to avoid loss or incorrect placement of parts during reassembly.

The detail drawings Attachment 9c and Attachment 10b, should be examined prior to disassembly in order to familiarize personnel with the location of the various moving parts.

Valve poppets (4 & 10) (Attachment 9c) (6) (Attachment 10b) are not interchangeable and must be returned to the same location. By orienting the manifold (5) (Attachment 9c) (15) (Attachment 10b) prior to disassembly, poppets (4 & 10) (Attachment 9c) (6) (Attachment 10b) can be placed near their respective hole upon removal and cleaning. The flats on the poppets (4 & 6) (Attachment 9c) (6) (Attachment 10b) are not identical, and if reversed, would cause malfunctioning of the unit.

Pressure relief spring (11) (Attachment 9c) or (11) (Attachment 10b) and steel balls (12a) (Attachment 9c) or (10) (Attachment 10b) use extreme care to avoid misplacing these parts. Place in a separate container.

7.1.5.1 UNSCREW the bolts (3) (Attachment 9c) (2) (Attachment 10b) on the top edge of the manifold (5) (Attachment 9c) (15) (Attachment 10b).

7.1.5.2 PULL the manifold blocks (5) (Attachment 9c) (15) (Attachment 10b) off the piping on either side of the manifold.

7.1.5.3 UNSCREW the piping connections (4) (Attachment 10b) or (7) (Attachment 9c) on each side of the manifold, (5) (Attachment 9c) or (15) (Attachment 10b) insuring that the valve poppets (4 & 10) (Attachment 9c) or (6) (Attachment 10b) are segregated upon removal.

7.1 Unit Disassembly (Continued)

7.1.5.4 UNSCREW the bolt (13) (Attachment 9c) (16) (Attachment 10b) on the bottom left side using extreme care not to lose the steel balls contained within.

7.1.5.5 REMOVE all O-rings, clean parts, and PLACE on assembly bench.

NOTE:

Care should be taken to insure that backup washer, located in the 1/2-inch tube fitting, is removed and replaced properly.

New style - unit does not have external tubing (See Attachment 7).

7.1.5.6 BLEED the unit over drip pan as described in Initial Bleeding of Unit, Section 7.1.1.6 thru 7.1.1.8.

7.1.5.7 UNBOLT four Allen screws (1 & 7) (Attachment 10a) holding accumulator to main cylinder.

7.1.5.8 UNBOLT Allen screws (1) (Attachment 10b) holding valve manifold (5) (Attachment 9c) or (15) (Attachment 10b) to rear plate of main cylinder, PULL manifold to rear disengaging piping from front plate.

NOTE:

Upon removal of the accumulator (1) (Attachment 7) and valve manifold (15) (Attachment 10b) note location of o-rings. The machined surfaces where the o-rings are situated must match properly and be undamaged in order to provide proper sealing between components upon reassembly.

7.1.5.9 For disassembly of the accumulator (1) and main cylinder (4) (Attachment 7) follow Sections 7.1.3 and 7.1.4.

7.1 Unit Disassembly (Continued)

NOTE:

Binding of the end plates (6 & 14) (Attachment 10a) should be avoided by the rods uniformly due to the spring inside, unless the 5/16-inch rod is used.

For the main cylinder (4) remove external guide by unscrewing nuts on tie rods (6) (Attachment 7).

7.1.5.10 REMOVE seals, CLEAN parts, and PLACE on assembly bench.

NOTE:

The valve manifold, as pictured in Attachment 10b is similar to the old style except for external piping arrangement.

7.1.5.11 Disassemble the valve manifold following Section 7.1.5 as in the old style unit; however, with the same precautions to avoid loss of the small steel bearings (10) (Attachment 10b) which comprise the pressure relief system.

7.2 Unit Reassembly

7.2.1 Seal Installation

NOTE:

Prior to installation of the new o-rings check first to see that the metal surfaces are free of dust, dirt, and gunk before assembly.

7.2.1.1 SELECT the proper o-ring.

NOTE:

A good procedure to use is compare the old o-rings to the new ones to verify sizes and thickness by visual inspection, so be sure to keep old rings with respective component after removal.

7.2.1.2 CHECK the new o-ring to ensure it is free of any scratches or imperfections that may cause improper functioning.

NOTE:

(1) Be sure the smooth surface of the ring is not damaged during installation by fingernails, tools, or threads.

(2) Do not pinch the ring between the base and fitting. Pinching is a leading cause of o-ring failures.

(3) Watch for sharp edges on groove shoulder and fitting. Use of tools to ride over these areas, in addition to masking, often helps.

7.2.1.3 Before any installation, WET the ring and bearing surfaces with a light coat of the silicon fluid to be used.

NOTE:

(1) Leak-causing distortion can result if the o-ring is stretched too much. Wetting not only helps eliminate this, but also lets the rings seal naturally in grooves without twists or wrinkles.

(2) Remember, use only NEW silicon fluid as a wetting agent to avoid contamination of the fluid.

7.2 Unit Reassembly (Continued)

7.2.1.4 FLOW WASH the bearing surface with specified silicone fluid and WIPE the parts, if necessary. Use a lint-free cloth to wipe all parts, as necessary.

NOTE:

(1) If, during installation, you must stretch an o-ring or seal, stretch as little as possible and try to stretch uniformly. Once installed, be sure to remove any twists.

(2) When pushing a piston or other o-ring containing part into a cylinder or hole, push straight in and not with a turning motion. Turning motion tends to bunch and cut the o-ring eventually causing leakage.

(3) Most installations are simply the reverse of removal so keep in mind the procedures used for removing the old o-ring when installing the new ones.

(4) Backup rings are used to provide a firm surface against which the o-rings can press to avoid being extruded, under high pressure, into the clearance between the surfaces being sealed. Any movement between the surface with the o-ring extruded would result in a high wear rate leading to eventual failure.

7.2.1.5 INSTALL a backup ring so that it is on the downstream side of the o-ring if used individually, or on each side if the pressure alternates directions.

NOTE:

(1) Refer to the valve manifold detail on the drawing in Attachment 9c or 10b to determine correct placement backup ring(s).

(2) As a general rule, if care is taken during installation and done without haste, most problems can be avoided.

7.2.1.6 REPLACE o-rings, seals, and glands using a logical sequence of replacement.

NOTE:

Replace seals in one component at a time to avoid confusion, and, as a hint, segregate seals prior to installation and set near component for which they are to be installed.

7.3 Reassembly of Unit

NOTES:

(1) The order of reassembly should be the valve manifold (2) main cylinder (4), and finally the accumulator (1) (Attachments 7 & 8).

(2) On all bolted connections, refer to torque specifications of Attachment 12. Line Verifications for torquing during snubber reassembly are performed on Attachment 2. Manifold Tube Connectors which are not equipped with "flats" may be tightened snug tight and the associated signoff on Attachment 2 marked N/A.

(3) Torquing of the seal screw should not be performed until after the filling and bleeding process is complete.

(4) Minor adjustments may be made to new or existing parts by machining, lapping, or honing to obtain proper fit under the direction of the Cognizant Engineer to correct dimensional tolerances, surface finishes, or alignment. The fit, form, or function of the component must not be altered by the process.

(5) Snubber may have mounting screws on the front of the main cylinder, if so torque shall be the same as the mounting screws on the accumulator.

7.3.1 When assembling the accumulator, the front end plate must be COMPRESSED, or the 5/16" rod TIGHTENED on the indicator rod in order to reduce the difficulty of assembly.

NOTE:

(1) IMPORTANT use only SF 1154 Fluid.

(2) SF 1154 fluid is specified because of its flame resistance and radiation tolerance. SF 1154 shall be used to fill all rebuilt arrestors.

7.3.2 PUSH the piston rod (3) (Attachment 7 & 8) to its fully retracted position prior to filling.

7.3.3 After assembly of each component and prior to final assembly of unit, FILL the main cylinder (4) (Attachment 7 & 8) using the inlet port in the rear end plate for this purpose.

7.3.4 After filling the main cylinder (4) (Attachment 7 & 8), ATTACH the valve manifold (2) (Attachment 7 & 8) and then ATTACH accumulator in reverse sequence of disassembly. LOOSEN the 5/16-inch rod on indicator rod, if used.

7.3 Reassembly of Unit (Continued)

NOTE: Some model snubbers may contain inaccessible front accumulator mounting cap screws. These cap screws may be torqued using a shop fabricated tool or crowsfoot to establish the specified torque provided the tool is used at a 90° angle to the torque wrench lever to obtain the required torque as specified in MSI-0-000-PRO017.

7.3.5 On the old-style unit, the tube connecting the valve manifold (2) to the main cylinder (4) (Attachment 8) must be ADJUSTED to the proper length and the 1/2-inch tube fitting TIGHTENED as part of the reassembly.

7.3.6 TIGHTEN tube after torquing tie rods (8 & 9) (Attachment 10a) (10 & 10a) (Attachment 9a).

NOTE:

The new-style unit does not require adjustment of this tube since it is factory-welded to the proper length.

7.3.7 After assembly is complete, FILL the accumulator (1) (Attachment 7 & 8) using the filler plug with the proper fluid as noted above (i.e., SF-1154) (4) (Attachment 9a) (2) (Attachment 10a).

7.3.8 FILL the accumulator (1) (Attachment 7 & 8) until the indicator rod (1) (Attachment 3) extends beyond the "EXT" setting on the indicator fluid level gauge (3) (Attachment 3).

7.3.9 BLEED the unit using the seal screw (5) (Attachment 9a) (2) (Attachment 10a) next to the filler plug.

7.3.10 CHECK the unit by gradually compressing the main piston rod (3) (Attachment 7 & 8).

7.3.11 If it feels spongy, continue bleeding the accumulator (1) (Attachment 7) until a solid pressure can be felt on the main piston rod (3) (Attachment 7 & 8). This may take several strokes.

7.3.12 When the filling and bleeding of the accumulator (1) (Attachment 7 & 8) is complete, INSTALL an aluminum spacer ring, such as Lincoln of St. Model No. 63086, on the filler fitting (4) (Attachment 9a) (13) (Attachment 10a).

7.3.13 Torque the seal screw (5) as specified on Attachment 12. Verification is to be performed on Attachment 2.

7.3 Reassembly of Unit (Continued)

7.3.14 SET piston rod (3) (Attachment 7 & 8) at noted extension dimension by either extending or compressing piston rod (3) (Attachment 7 & 8).

7.3.15 USE the information provided on the tag attached to the piston rod (3) (Attachment 7 & 8).

7.3.16 COMPARE this setting with the detail drawings, and if a discrepancy exists, CONTACT the Snubber Engineer or Snubber Specialist.

NOTE:

Due to field tolerances, adjustment of the piston rod is acceptable as long as a one-inch stroke reserve measured on the fluid level indicator (5) (Attachment 7 & 8) is maintained.

7.3.17 SET unit on clean paper for at least one hour to check for leaks.

7.3.18 Allowing at least 10 minutes after cleaning, EXAMINE all fittings, joints, and seals for leakage.

7.3.19 Pipe threads or reservoir tie rods should be tightened if loose.

7.3.20 "Tite Joint" tape or equivalent may be used as required on pipe threads.

7.3.21 Do not attempt to tighten cylinder tie rods.

7.3.22 Slight dampness does not require correction. Suppressor will function normally as long as it maintains a reserve of fluid between inspections.

7.3.23 If the suppressor is subject to moisture, high humidity, or vibration, GREASE ball bushing fittings provided, as required. Use a high-quality grease, GP-2 for this application.

NOTE:

It is recommended that a log be made for each unit noting the following:

Assembly mark number
Piston rod extension dimension
Fluid level indicator setting
Notation on visible condition of unit

8.0 TESTING

8.1 The functional testing and corrective adjustments are to be performed in accordance with 0-SI-4.6.H-2B.

9.0 RETURN TO SERVICE

9.1 CLEAN entire assembly and DRY any accumulations of fluid, especially around fluid-containing joints or fittings.

9.2 GREASE self-aligning bushings, if provided with grease fittings.

9.3 INSPECT piston rod for damage or corrosion. Rough surface on the rod may cause the rod seal to leak.

9.4 INSPECT level of fluid supply, and replenish as necessary. Fluid type is SF 1154 only.

9.5 ENSURE that all work performed under this procedure is documented in the work performed section of the Work Order.

END OF TEXT

ATTACHMENT 1
(Page 1 of 1)

DATA COVER SHEET

DATE ____/____/____

UNIT ______________ WO#______________

Performed by: (List All Persons)

NAME (Print)	NAME (Signature)	INITIALS	DATE

The following work was performed per the appropriate instructions and met any applicable quality assurance requirements.

Verify ________________________________/______________
Foreman Date

Signature attests that I understand the scope and purpose of this instruction and that, to the best of my knowledge, it was properly performed in accordance with instructions in that: The recording, reduction, and evaluation of data were complete and correct; acceptance criteria were met and dispositioned; and instruction was fully complete except as noted.

Verify ________________________________/______________
Cognizant Reviewer Date

Comments: (Comments shall be initialed and dated)

____

____

____

ATTACHMENT 2 (Page 1 of 2)

DISASSEMBLY AND REASSEMBLY OF BERGEN-PATERSON AND ANCHOR/DARLING HYDRAULIC SHOCK AND SWAY ARRESTORS

UNIT NO. _____ ARRESTOR SERIAL NO. (MFG) _____________ ARRESTOR SIZE _________

	Craftsman / DATE
Correct repair parts were installed in snubber.	______/______
New ethylene propylene material Seals and o-rings installed.	______/______
Snubber accumulator to main cylinder aligned properly.	______/______
Snubber reassembled properly and serviced with proper fluid type (SF 1154) and fluid level.	______/______
Snubber has no evidence of leakage following reassembly.	______/______

List Issue Ticket numbers for snubber repair parts and fluid in the Work Order.

Craftsman shall initial performance of work and Line Verifier to verify snubber reassembly torque as applicable from Attachment 12.

NOTE: Parts identified with (E) apply to external tubing type snubbers only.

ACCUMULATOR	**CRAFTSMAN**	**M&TE # / CAL DUE DATE**	**LINE VERIFIER / DATE**
TIE RODS	____	______/______	______/______
PROTECTIVE TUBE NUT	____	______/______	______/______
MOUNTING SCREWS	____	______/______	______/______
FILLER PLUG	____	______/______	______/______
0.25 TUBE FITTING (E)	____	______/______	______/______
SEAL SCREW	____	______/______	______/______

CHECK VALVE	**CRAFTSMAN**	**M&TE # / CAL DUE DATE**	**LINE VERIFIER / DATE**
PORT PLUGS	____	______/______	______/______
RELIEF VALVE PLUG	____	______/______	______/______
MANIFOLD CONNECTOR (E)	____	______/______	______/______
MAN. TUBE CONNECTOR	____	______/______	______/______
MANIFOLD SCREW	____	______/______	______/______
0.50 TUBE FITTINGS (E)	____	______/______	______/______
POPPET STOP & PLUG	____	______/______	______/______

CYLINDER	**CRAFTSMAN**	**M&TE # / CAL DUE DATE**	**LINE VERIFIER / DATE**
TIE RODS	____	______/______	______/______
PISTON ROD	____	______/______	______/______
(ADH) MOUNTING SCREWS	____	______/______	______/______

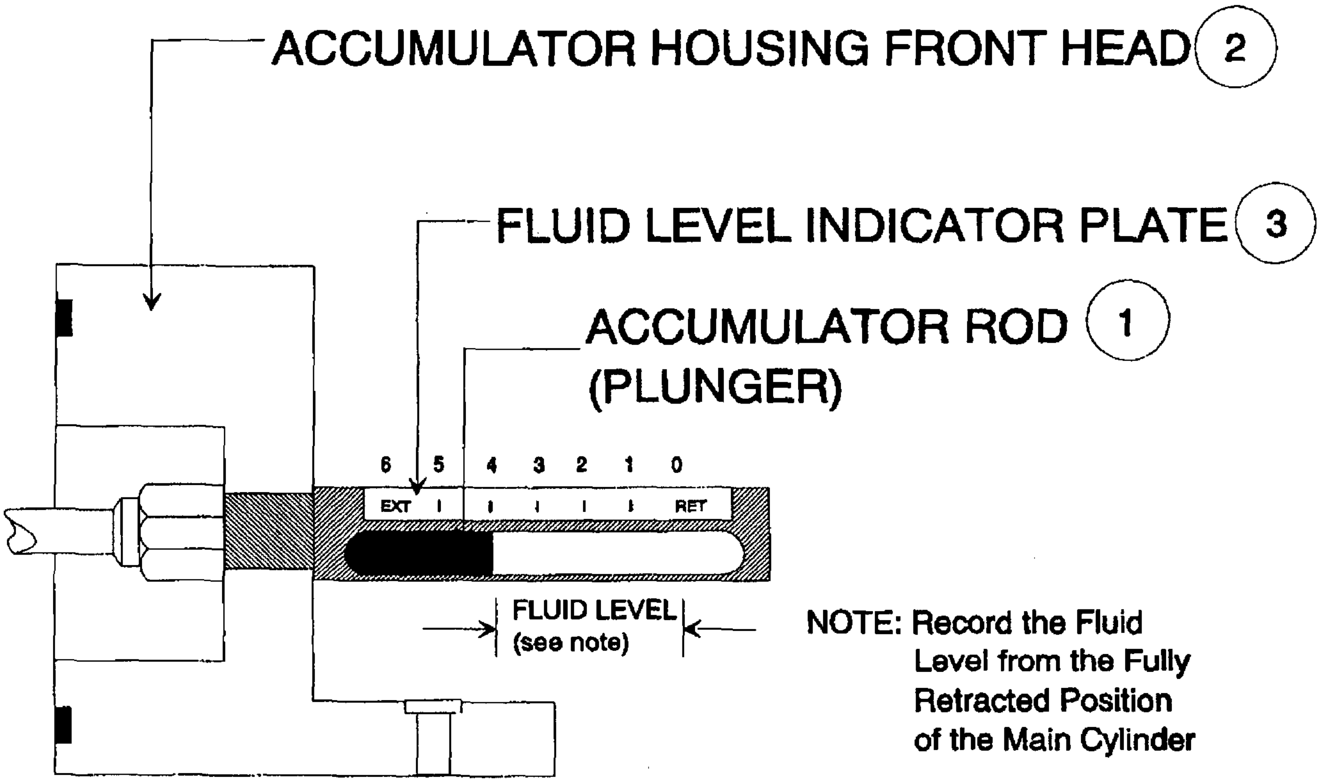
ANI/ANII work package review performed if required. ____________/______
Foreman Date

ATTACHMENT 2 (Page 2 of 2)

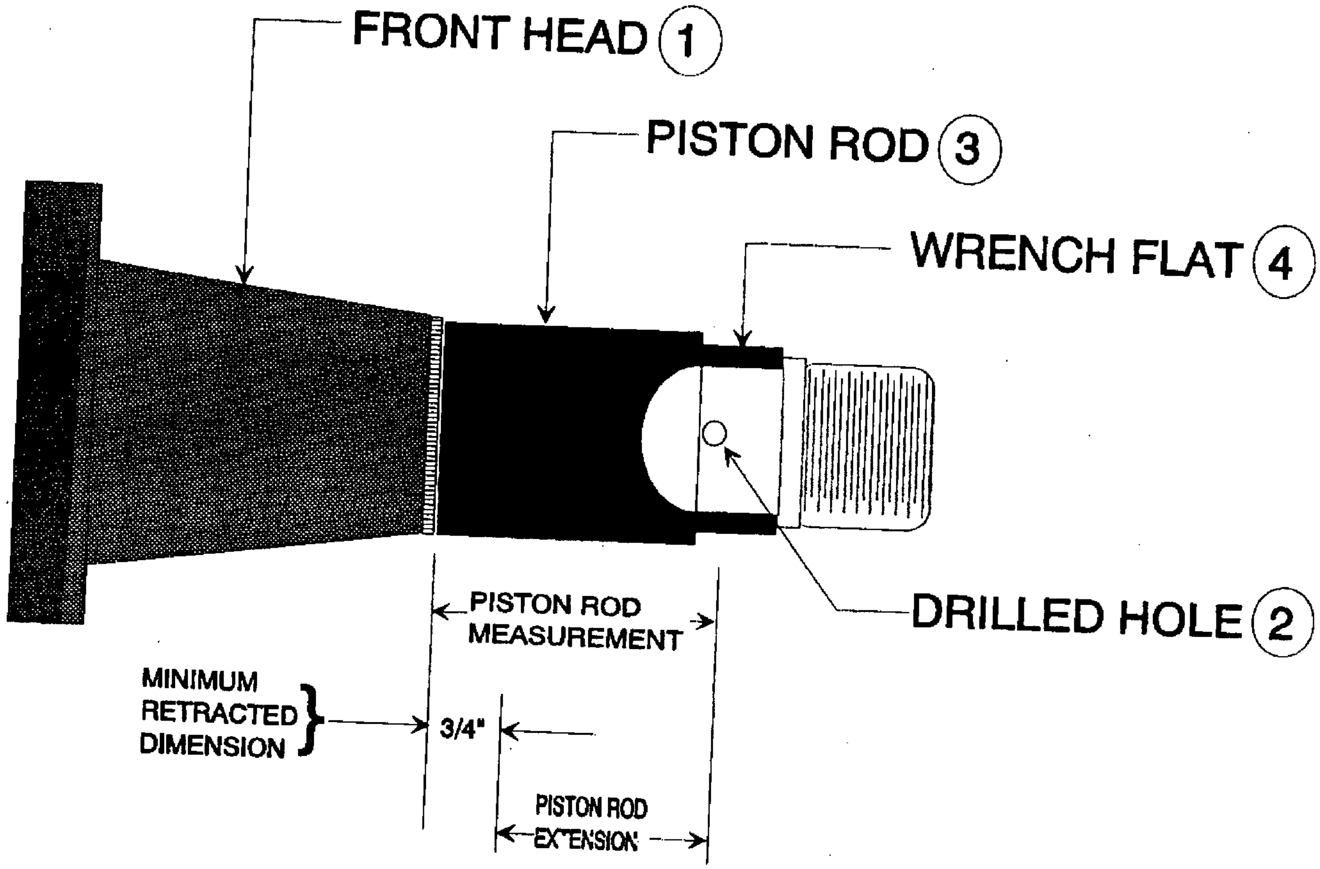
DISASSEMBLY AND REASSEMBLY OF BERGEN-PATERSON AND
ANCHOR/DARLING HYDRAULIC SHOCK AND SWAY ARRESTORS

REMARKS:

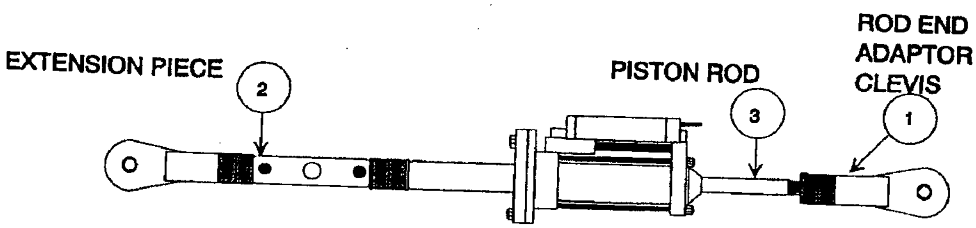
ATTACHMENT 3
PAGE 1 OF 1



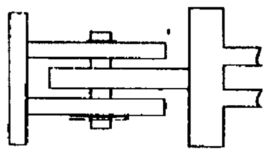
ATTACHMENT 4
PAGE 1 OF 1



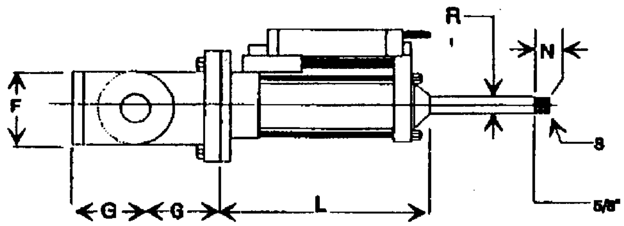
ATTACHMENT 5
PAGE 1 OF 1



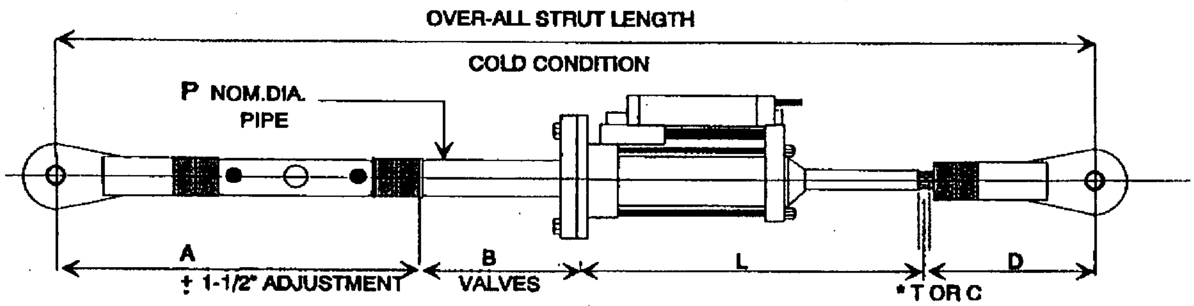
ATTACHMENT 6
PAGE 1 OF 1



MOUNTING "B"
LUG HORIZONTAL



MOUNTING "A"
LUG VERTICAL

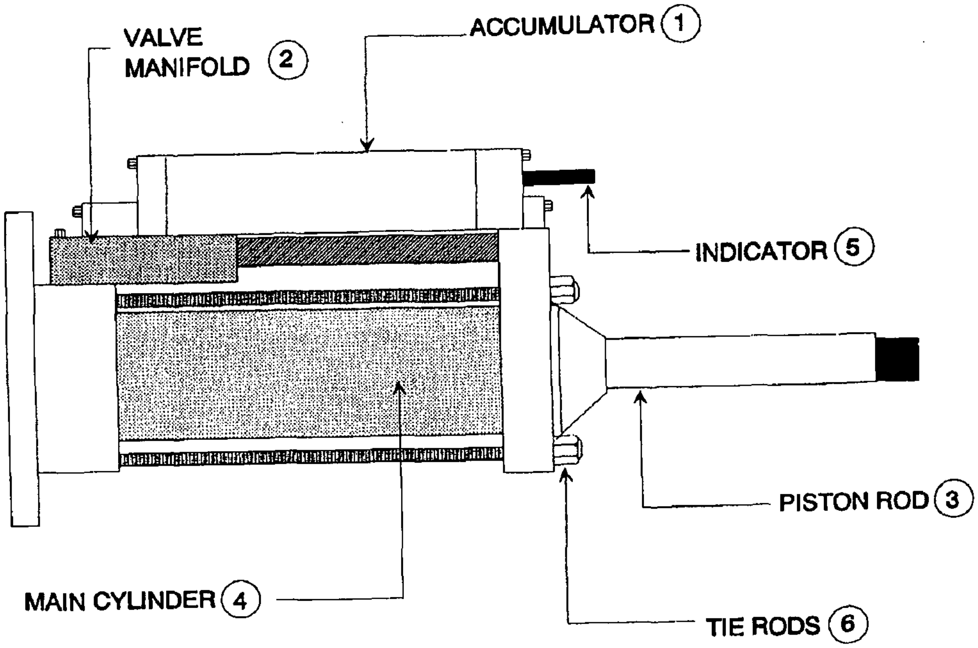


* TO BE SPECIFIED BY CUSTOMER FOR SETTING SEE DETAIL BELOW.

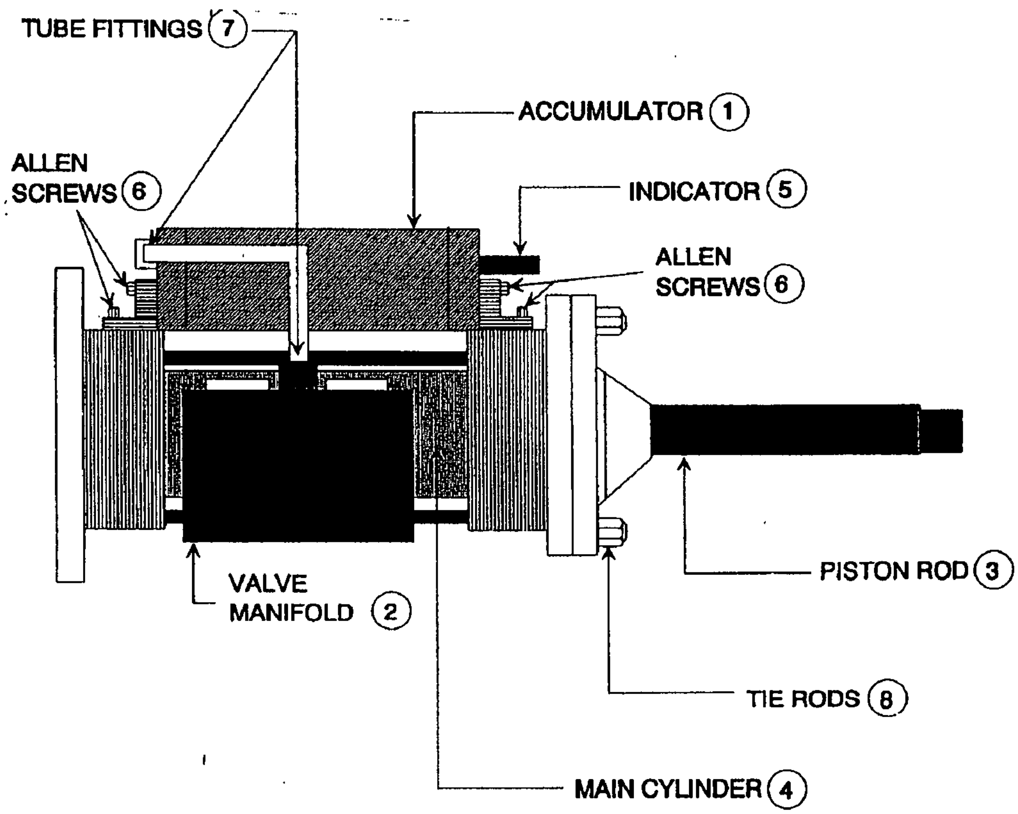
HSSA * FORCE * STROKE * WEIGHT

SIZE	MAX. FORCE LBS.	BORE	STROKE	L	T or C		Hydraulic Unit Wt. (Approx.) Lbs.
					Fully Retracted	Fully Extended	
HSSA-10	10,000	2-1/2	6	16	3/4	6 3/4	37
			12	22	3/4	12 3/4	45
			18	28	3/4	18 3/4	54
HSSA-20	20,000	3-1/4	6	17	3/4	6 3/4	48
			12	23	3/4	12 3/4	60
			18	29	3/4	18 3/4	72
HSSA-30	30,000	4	6	17 1/2	3/4	6 3/4	70
			12	23 1/2	3/4	12 3/4	87
			18	29 1/2	3/4	18 3/4	104

ATTACHMENT 7
PAGE 1 OF 1



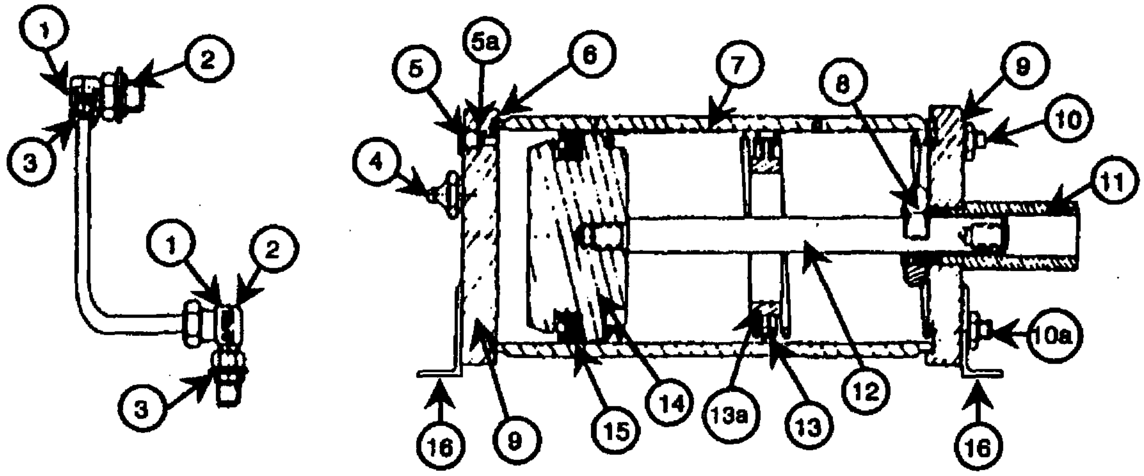
ATTACHMENT 8
PAGE 1 OF 1



BERGEN-PATERSON
EXTERNAL PIPE CONFIGURATION

ATTACHMENT 9A
(Page 1 of 1)

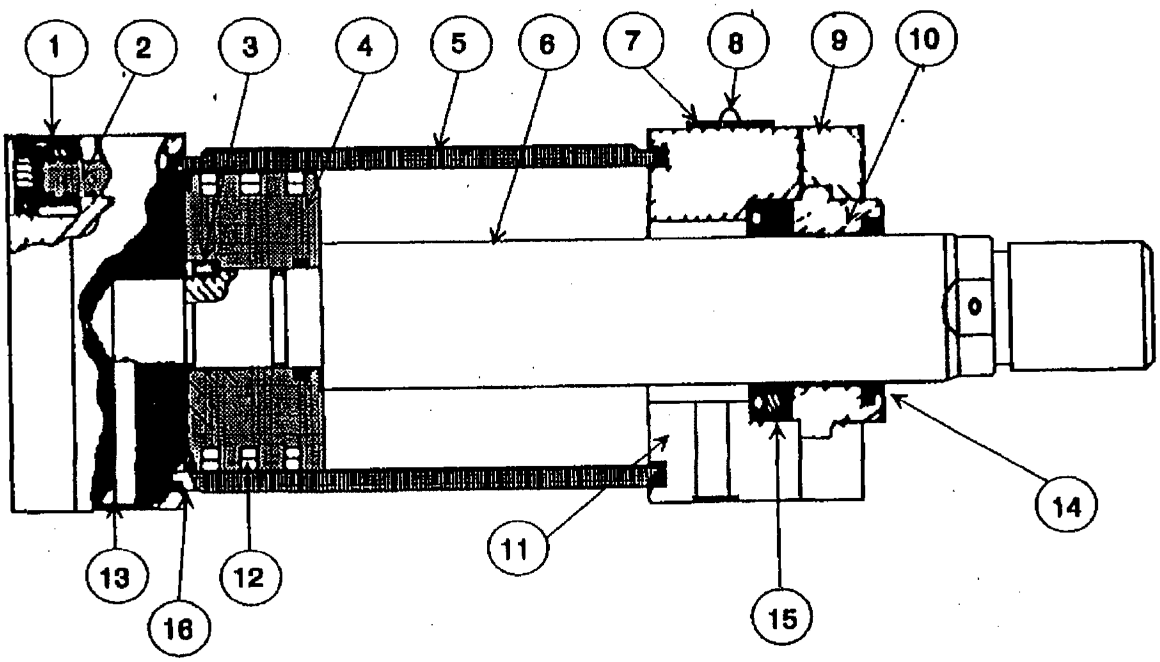
EXTERNAL PIPE
BERGEN PATERSON SNUBBER



1 Backup washer
2 O-Ring
3 O-Ring
4 Filler Plug
5 Seal Screw
5a O-Ring
6 O-Ring
7 Reservoir Tube
8 Lock nut
9 Reservoir Head
10 Tie Rod - Short
10a Tie Rod - Long
11 Protective Tube
12 Tall Rod
13 Spring Guide
13a Reservoir Spring
14 Reservoir Piston
15 Piston Packing
16 Mounting Flange

ATTACHMENT 9B
(Page 1 of 1)

EXTERNAL PIPE BERGEN PATERSON SNUBBER

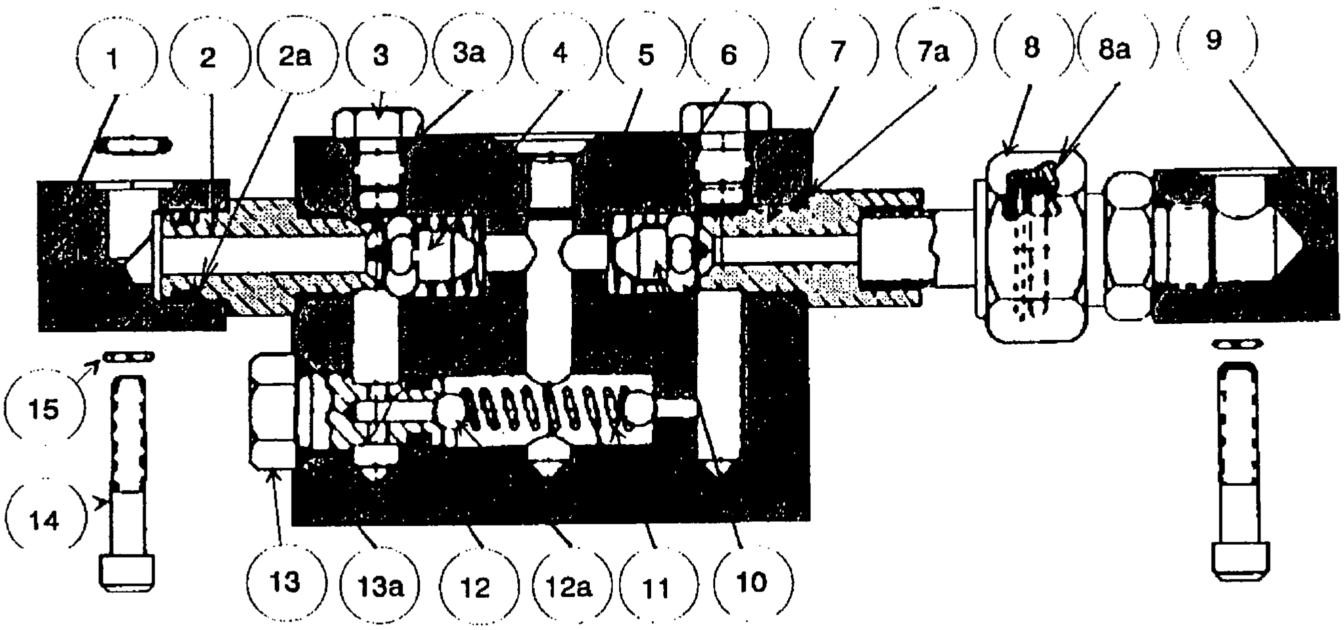


***1 Tie Rod Nut**
***2 Tie Rod**
***3 Lock Pin**
***4 Piston**
***5 Cylinder Tub**
***6 Piston Rod**
7 Name Plate
8 Drive Screw
***9 Reservoir Head**
***10 Gland**
***11 Head**
***12 Piston Ring**
***13 Cap (End Plate)**
14 Rod Wiper
15 Rod Packing
16 O-Ring Seals

*** ASME Section XI parts which require ANI/ANII review of work package when replaced.**

ATTACHMENT 9C
(Page 1 of 1)

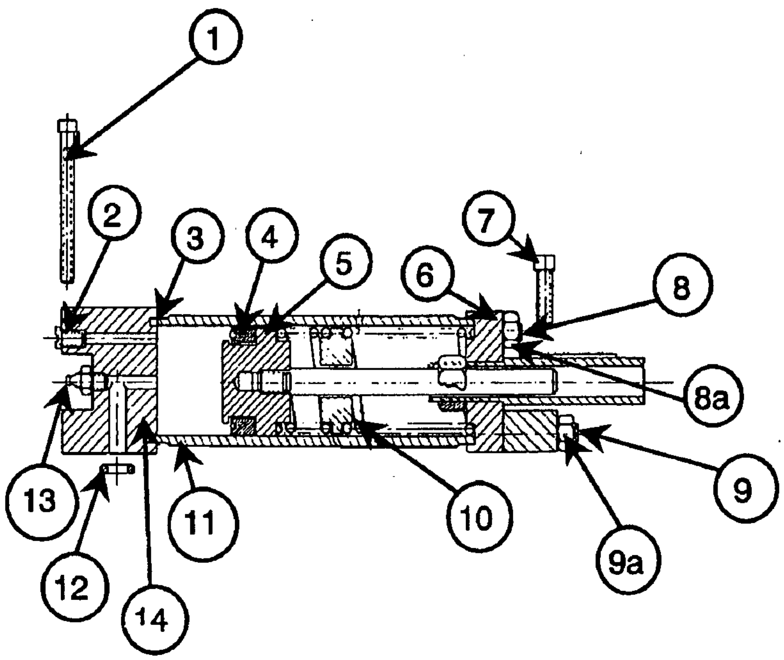
EXTERNAL PIPE BERGEN PATERSON SNUBBER



1. Rear Manifold Block
2. Manifold Connector
2a. O-Ring
3. SAE Port Plug
3a. O-Ring
4. Poppet (Compression)
5. Flow Control Body
6. Popper Spring
7. Manifold Tube Connector
7a. O-Ring
8. 1/2" Tube Fitting
8a. Back up Washer
9. Front Manifold Block
10. Popper (Extension)
11. Relief Valve Spring
12. O-Ring
12a. Relief Valve Ball
13. Relief Valve Seat
13a. O-Ring
14. Manifold Screw
15. Lock Washer

ATTACHMENT 10A
PAGE 1 OF 2

RESERVOIR ASSEMBLY

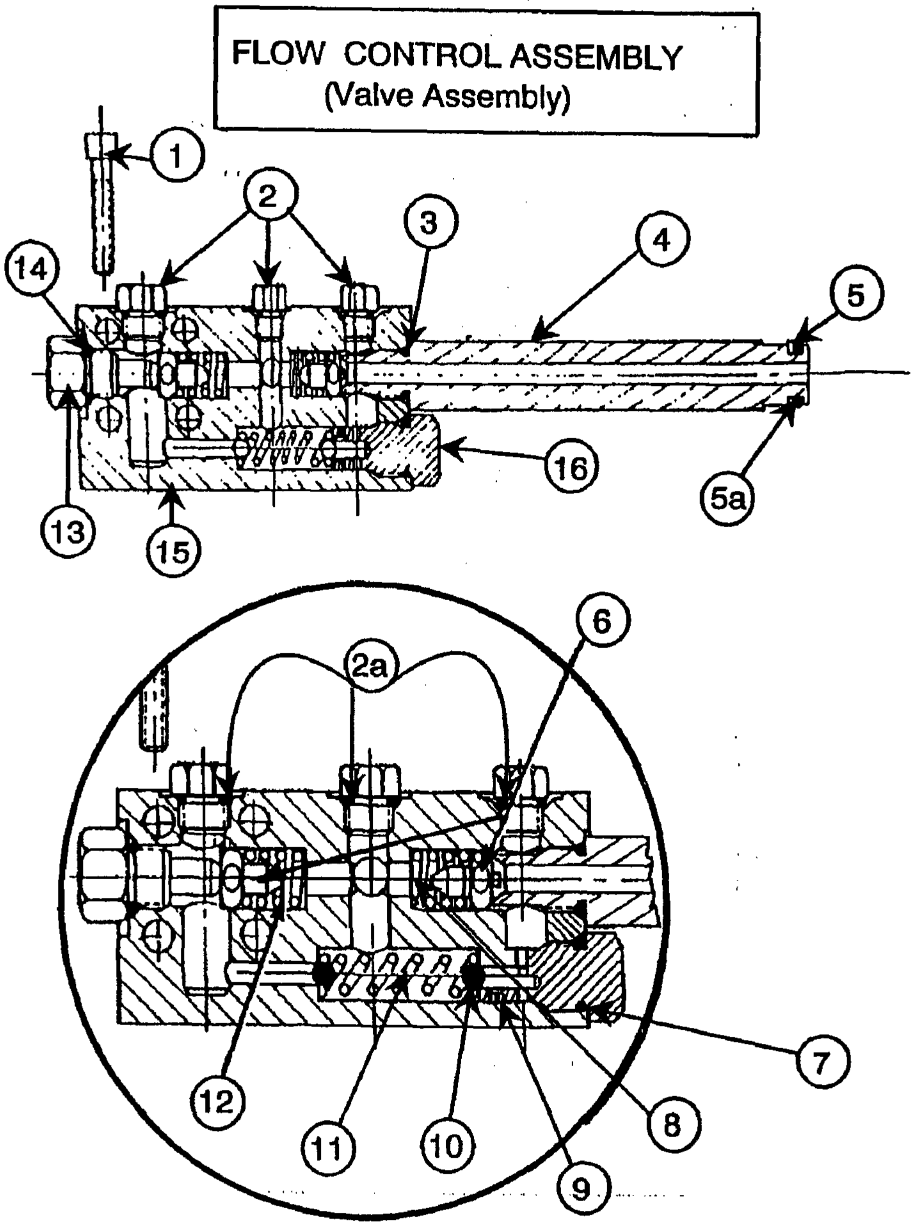


ATTACHMENT 10A
(Page 2 of 2)

Reservoir Assembly

1	Rear Mounting Screw - Long
2	Seal screw
3	Reservoir Tube
4	Piston Packing
5	Reservoir Piston
6	Reservoir Head
7	Front Mounting Screw - Short
8	Tie Rod - Short
8a	Tie Rod Nut
9	Tie Rod - Long
9a	Tie Rod Nut
10	Spring
11	Cylinder Tube
12	O - Ring
13	Filler Plug - Fitting
14	Rear Plate

ATTACHMENT 10B
PAGE 1 OF 2

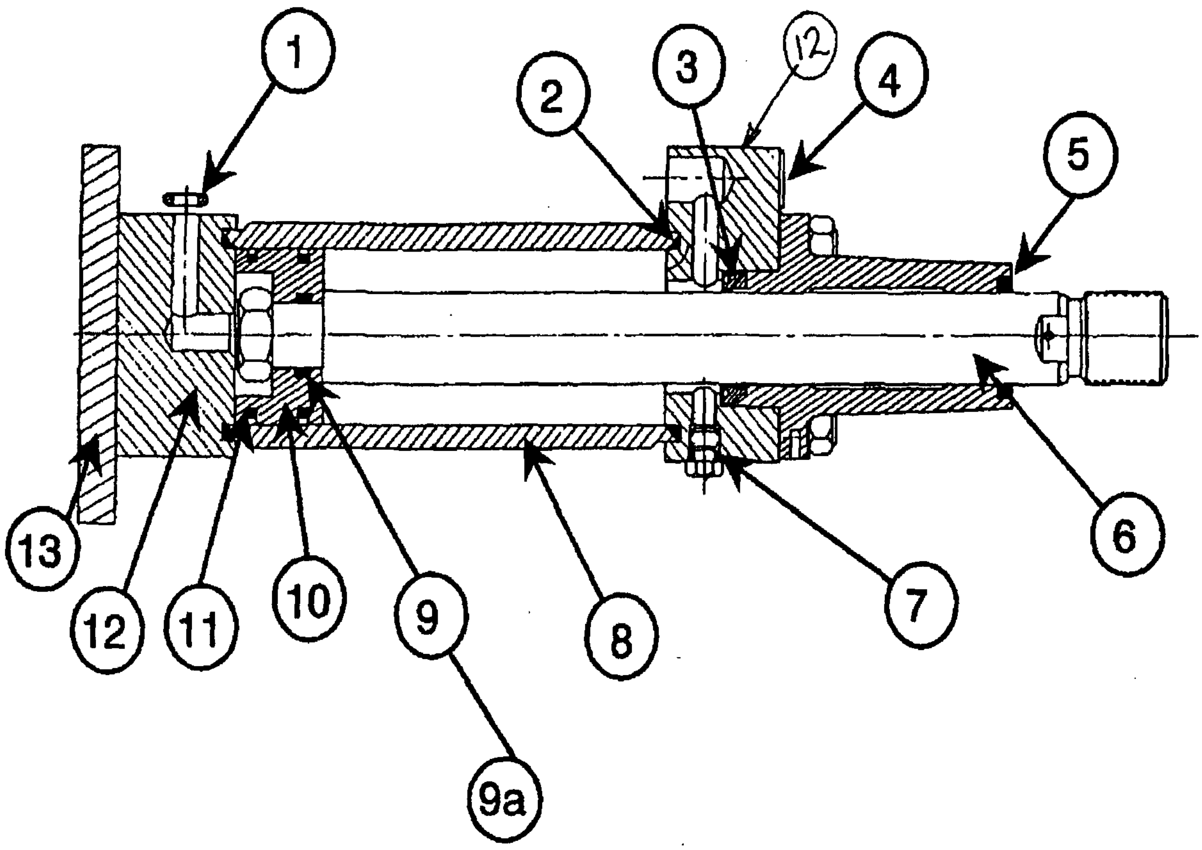


ATTACHMENT 10B
(Page 2 of 2)

1	Rear Mounting Screw - Long
2	SAE Port Plug
2a	O-Ring
3	O-Ring
4	Connector Plug
5	O-Ring
5a	Back - Up Washer
6	Poppet (Extension)
7	O-Ring
8	Poppet Spring
9	O-Ring
10	Relief Valve Ball
11	Relief Valve Spring
12	Poppet Spring
13	Poppet Stop and Plug
14	Popper (Compression)
15	Flow Control Body
16	Relief Valve Plug

ATTACHMENT 10C
PAGE 1 OF 2

MAIN CYLINDER ASSEMBLY



ATTACHMENT 10C
(Page 2 of 2)

1	O-Ring
2	O-Ring
3	Rod Packing
4	Name Plate
5	Rod Wiper
***6**	Piston Rod
7	O-Ring
***8**	Cylinder Tube
9	O-Ring
9a	O-Ring
***10**	Piston
***11**	Piston Ring
***12**	Cap
***13**	Mounting Flange

*** ASME Section XI parts which require ANI/ANII review of work package when replaced.**

ATTACHMENT 11
(Page 1 of 1)

RESERVE FLUID

SIZE	CYLINDER		ACCUMULATOR		ROD		RESERVE	
	BORE	AREA	BORE	AREA	DIA.	AREA	CU. IN.	INCH
HSSA-3	1-1/2	1.77	2.00	3.14	1	.78	3.1	.99
HSSA-10	2-1/2	4.91	2.50	4.91	1-3/8	1.48	5.21	1.06
HSSA-20	3-1/4	8.29	3.25	8.29	1-3/4	2.40	8.80	1.06
HSSA-30	4	12.57	4.00	12.57	2	3.14	14.10	1.12
HSSA-50	5	19.63	5.00	19.63	2-1/2	4.91	22.00	1.12

TORQUE SPECIFICATIONS HYDRAULIC UNITS

Size	1.5 BORE 3,000 lbs.	2.5 BORE 10,000 lbs.	3.25 BORE 20,000 lbs.	4.00 BORE 30,000 lbs.	5.00 BORE 50,000 lbs.	6.00 BORE 70,000 lbs.	8.00 BORE 130,000 lbs.
ACCUMULATOR							
TIE RODS	80 IN.- LBS	80 IN.- LBS	180 IN.- LBS	180 IN.- LBS	300 IN.- LBS	300 IN.- LBS	600 IN.- LBS
PROTECTIVE TUBE NUT	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS	18 FT - LBS
PISTON ROD	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY	EPOXY
MOUNTING SCREWS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS
FILLER PLUG	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS
0.25 TUBE FITTING (E)	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS
SEAL SCREW	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS	50 IN.- LBS
CHECK VALVE							
PORT PLUGS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	20 FT - LBS	40 FT - LBS
RELIEF VALVE PLUG	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
MANIFOLD CONNECTOR (E)	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
MANIFOLD TUBE CONNECTOR	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
MANIFOLD SCREW	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS
0.50 TUBE FITTINGS (E)	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	N/A	N/A
POPPET STOP & PLUG	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	40 FT - LBS	350 FT - LBS
CYLINDER							
TIE RODS	30 FT - LBS	60 FT - LBS	100 FT - LBS	160 FT - LBS	230 FT - LBS	300 FT - LBS	700 FT -LBS
PISTON ROD	50 FT - LBS	270 FT.- LBS	475 FT.- LBS	750 FT.- LBS	1100 FT.- LBS	1700 FT.- LBS	2000 FT -LBS
(ADH) MOUNTING SCREWS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	90 IN.- LBS	160 IN.- LBS

NOTE: Parts identified with (E) apply to external tubing type snubbers only.

Attachment I

BFN MECHANICAL PREVENTIVE INSTRUCTION

MPI-0-000-SNB004,

Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers

TENNESSEE VALLEY AUTHORITY

BROWNS FERRY NUCLEAR PLANT

MECHANICAL PREVENTIVE INSTRUCTION

MPI-0-000-SNB004

REMOVING AND REINSTALLING PACIFIC SCIENTIFIC MECHANICAL, BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC AND BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINT SNUBBERS

REVISION 32

PREPARED BY: MACK SMITH PHONE: 6113

RESPONSIBLE ORGANIZATION: MECHANICAL MAINTENANCE

APPROVED BY: JERRY SCHLESSEL DATE: 05/13/2006

EFFECTIVE DATE: 05/15/2006

LEVEL OF USE: REFERENCE USE

QUALITY-RELATED

REVISION LOG

Procedure No. MPI-0-000-SNB004 REV: 032

Pages Affected: 2 and 4

Description of Change:

TR-033 - Revised Step 7.2.1 to incorporate changes per EDC 66240.

TABLE OF CONTENTS

1.0 PURPOSE/SCOPE/FREQUENCY

1.1 Purpose

This instruction is to serve as a guide in the removal and reinstallation of Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers. This procedure also serves as the pre-service inspection procedure for Sect XI Repair/Replacement snubber work order packages.

1.2 Scope

This instruction will ensure the removal and reinstallation of Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Hydraulic and Bergen-Paterson or Lisega Torus Dynamic Restraint Snubbers are performed properly.

1.3 Frequency

[PER/C] Frequencies are established and maintained in accordance with the plant Preventive Maintenance (PM) Program and Qualification Maintenance Data Sheets (QMDS), as applicable, Surveillance Instructions or as required for maintenance. [PER BFPER940037]

2.0 REFERENCES

BFN-VTD-B209-0160, Vendor Technical Manual For Bergen-Paterson Reactor Torus Ring Hydraulic Shock Suppressers.

BFN-VTD-B209-0180, Installation Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressers.

BFN-VTD-B209-0200, Removal Techniques For Bergen-Paterson Series 78000 Hydraulic Shock Suppressers.

BFN-VTM-P029-0010, Vendor Technical Manual For Pacific Scientific Instruction Manual for Repair, Overhaul, Installation Maintenance of Mechanical Shock Arrestors.

BFN-VTD-P029-0050, Pacific Scientific Instruction Manual For Installation and Maintenance of Mechanical Shock Arrestors Models PSA-1/4, PSA-1/2, PSA-1, PSA-3, PSA-10, PSA-35, PSA-100

BFN-VMM-P029-0250, Vendor Miscellaneous Manual For Pacific Scientific Mechanical Shock Arrestors.

BFN-VTM-G257-0010, Vendor Technical Manual For Grinnell Corp. Hydraulic Snubbers

BFN-VTM-L329-0010, Vendor Technical Manual For Lisega Reactor Torus Ring Hydraulic Snubbers

BFN-VTD-L329-0070, Installation and Maintenance Instructions For Lisega Hydraulic Snubbers

0-TI-397, Performance of Inspection/Verification by Maintenance

EDC 66240, Revise General Notes (Drawing 0-47B435-5B)

3.0 PRECAUTIONS/LIMITATIONS/ALARA

3.1 When removing or reinstalling a snubber, do not rotate the piston rod end of the unit. If the snubber cannot be removed or installed without rotating the piston, contact the Snubber Engineer/designee for instruction.

3.2 Only remove one snubber at any time from a safety-related system while that system is required to be operable.

3.3 Caution should be taken not to drop any spacers, washers, cotter pins, etc., while removing end attachments.

3.4 Safety measures must be used to ensure personnel safety when working on difficult to reach snubbers.

3.5 At no time shall snubbers be used as steps or hand holds.

3.6 Use care when removing or installing attachment pins to avoid damage to end attachments and spherical bearings.

3.7 Line Verifier is defined in NADP-1, Conduct of Quality Assessment and Inspection.

4.0 PREREQUISITES

4.1 The Snubber Engineer/designee, shall be notified prior to work being performed on any snubber.

4.2 The Snubber Engineer/Designee, shall verify the correct support and ISI isometric drawings are in the Work Order prior to work beginning.

5.0 RECOMMENDED EQUIPMENT - Use as required

5.1 Common to all Snubbers

1/2" drive socket set.
Vise grips.
Needle nose pliers.
Hammer, Rubber hammer, Mallet or soft-faced hammer.
Brass drift pin.
Slip-joint pliers.
Torque wrench, 1/2" drive (5 to 250 ft-lbs.)
Rigging-slings, hoist, etc.
Ladders and scaffolding, Safety belt.
Snap ring pliers, Lock wire pliers, Lock wire stainless steel.
Flashlight, Inspection mirror.
File, fine tooth.
Cotter pins.
Tie wire.
Adjustable wrench's (8" or 12") screwdriver (1/4" or 1/8" blade).

5.2 Bergen-Paterson Torus Dynamic Restraint Snubbers Tools

NOTE: Part numbers furnished in this procedure are for reference only.

Positioning fixture (BP P/N 78044).
Hand spanner wrench (BP P/N 78031).
Lifting fixture (BP P/N 78048).
Jam nut torquing fixture (BP P/N 78022).
Porta-power.

6.0 ACCEPTANCE REQUIREMENTS - None.

7.0 INSTRUCTION STEPS

7.1 Follow the appropriate Removal and Reinstallation Attachment for the type snubber to be worked. Steps deemed inapplicable to the specific type of snubber to be worked may be marked N/A (Not Applicable) with prior concurrence from the Work Supervisor. Concurrence must be documented in the Remarks Section of Attachment 1.

7.1.1 Removal and Reinstallation of Bergen-Paterson, Anchor/Darling, Fronek, Grinnell Hydraulic Snubbers (Reference Attachment 1). Instructions for replacing old solid pins with the new two piece pin are found in step 7.3.

7.1.2 Removal and Reinstallation of Mechanical Pacific Scientific Snubbers (Reference Attachment 2). Instructions for replacing old solid pins with the new two piece pin are found in step 7.3.

7.1.3 Removal and Reinstallation of Bergen-Paterson or Lisega Torus Dynamic Restraints (Reference Attachment 3). Instructions for replacing old solid pins with the new two piece pin are found in Attachment 3.

7.2 Staking of Carbon Steel Spherical Bearings (as applicable):

NOTES:

(1) Stainless steel bearings are NOT to be staked. If any are found to be dislodged, notify the Snubber Engineer/designee for instruction.

(2) The following is a list of Bergen-Paterson part numbers for strut and snubber assemblies which use carbon steel and stainless steel spherical bearings:

- These part numbers use stainless steel bearings: 2015, 2249 (end attachment end), 2250, 2251 (end attachment end), 2252, 2410 (end attachment end), 2411 (end attachment end), 2420, 2421, 2440, 2525, 2530, and 2540 (end attachment end).

- These part numbers use carbon steel bearings: 2000, 2010, 2100, 2200, 2249 (clamp end), 2251 (clamp end), 2410 (clamp end), 2411 (clamp end), 2510, 2515, and 2540 (clamp end).

7.2.1 If a snubber contains a carbon steel spherical bearing which has become dislodged, the spherical bearing shall be staked in accordance with paragraph 7.2.3, unless it has been previously staked. If the bearing has been staked previously, request the Site Engineering Lead Civil Engineer to provide needed corrective action.

7.2.2 If a spherical bearing is found to be dislodged from the paddle housing, REINSERT by carefully pressing or tapping on the outer race. Use a Bergen-Paterson bearing installation tool or an appropriate sized pipe to assure proper alignment.

7.2.3 After the spherical bearing has been reinserted into the paddle if required, USE a center punch and MOVE approximately 1/32 inch away from the exterior of the spherical bearing race and with as little force as possible MAKE four punch indentations equally spaced around the race at approximately 90 degrees, on both sides of the paddle.

7.2 Staking of Carbon Steel Spherical Bearings (continued):

7.2.4 The punch indentations should displace a small amount of metal over the edge of the spherical bearing race to keep it from dislodging again.

7.2.5 The spherical bearing race is a hardened material and shall be LOOKED at very closely to VERIFY the staking process has not damaged the race in any way, such as cracking, deforming, chips or flaking.

7.2.6 VERIFY the ball moves with little force in the race.

7.2.7 If the ball sticks, ROTATE it to expose the exterior surface and PLACE a small amount of Never-Seize compound on it.

7.2.8 MOVE the ball around until it moves with little force.

7.2.9 If the ball does not move with little force after this, contact the Snubber Engineer/designee to evaluate the spherical bearing.

7.3 Replacing Original One Piece Pins with New Two Piece Pins (as applicable)

NOTE: Pin replacement may begin on either end of the snubber. After the first pin is replaced the steps are repeated to replace the pin on the opposite end.

7.3.1 REMOVE original pin, retainers, and spacer washers. Retain spacer washers for reinstallation. Discard old pin and retainers.

7.3.2 VERIFY the bore of the bracket and bearing are free of burrs, rust, and debris.

7.3.3 DISASSEMBLE new pin by removing the slotted hex nut, washer, and sleeve.

7.3.4 APPLY a thin film of lubricant to the OD of the sleeve and to the threads and tapered surface of the pin. USE Never Seez Pure Nickel, Neolube 1 or 2, Felpro C5-A Nuclear Grade, Fel-Pro N-7000 or G.E. Silicone Grease, G-351.

7.3.5 ALIGN hole in spherical bearing with bracket lug holes. INSTALL sleeve and spacer washers - insuring that sleeve is in full contact with holes in the bracket lugs.

7.3.6 INSTALL pin and attach washer and slotted hex nut.

7.3.7 ADJUST pin sleeve assembly by tightening the slotted hex nut snug until spherical bearing will not slide along sleeve. Insure that the spherical bearing is centered, approximately, between the bracket lugs.

7.3.8 INSTALL cotter pin by slightly turning the slotted hex nut in either direction, as required, to allow the cotter pin to be inserted in the first available hole.

7.3.9 SPREAD legs on cotter pin enough to prevent falling out.

ATTACHMENT 1 (Page 1 of 9)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

NOTES:

(1) The pivot pins and pipe clamp stud bolts are designed to be a light press fit in the snubber spherical bearing and in the attachment lug or pipe clamp.

(2) Removal/Reinstallation of snubbers is to be performed generally in accordance with the following steps. The steps may be performed out of sequence as required to best facilitate the flow of work.

(3) Document removal and reinstallation data for the snubber on Attachment 4.

1.0 REMOVAL OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

1.1 PERFORM visual inspection of the snubber for any visible damage or fluid leakage.

1.2 ENSURE snubber attachment fasteners are not loose or missing prior to unpinning the snubber(s).

NOTE: IF visible damage such as loose/missing attachment fasteners, or unacceptable conditions such as low fluid level or leakage are discovered, NOTIFY the Snubber Engineer/designee to initiate a PER in accordance SPP-3.1, Corrective Action Program, and evaluate the condition in accordance with Attachment 5 or 6 as appropriate.

1.3 For Bergen-Paterson, Anchor/Darling, and Fronek snubbers, MEASURE the "As-Found" index/piston position setting as follows (see Illustration 1). RECORD the value on Attachment 4 to the nearest 1/8 inch.

1.3.1 If the reservoir plunger cannot be seen the fluid level is unacceptable and the snubber is visually inoperable

1.3.2 It the snubber is visually inoperable, NOTIFY the Shift Manager/Unit Supervisor immediately and the Snubber Engineer/Designee. Write a Work Order to REMOVE the snubber to the snubber test facility for a functional test to determine operability.

1.3.3 Record piston rod extension which is the distance from end of front head to the punch mark or scribed line on the piston to the nearest 1/8 inch and subtract (-) 3/4 inch.: ______ -3/4 =______ inches

1.3.4 Record the plunger reading from the scale along the protective tube:

Record Reservoir plunger reading from above: __________
Subtract piston rod extension from above: - __________
Calculated value: __________

1.3.5 If the calculated value above is greater than +2 inches, the fluid level is unacceptable.

1.3.6 If the fluid level is unacceptable, but not empty, add GE SF 1154 Silicon fluid using a hydraulic fluid gun until the fluid level reading is at or approximately the same as the piston rod extension given above. NOTIFY the Snubber Engineer/Designee to take appropriate action.

ATTACHMENT 1 (Page 2 of 9)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

1.0 REMOVAL OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

1.4 For Grinnell snubbers, MEASURE the "As-Found" position setting as follows (see Illustration 3). RECORD the value on Attachment 4 to the nearest 1/8 inch.

1.4.1 If the fluid in the plastic reservoir is below the supply hole for the snubber piston, the fluid level is unacceptable and the snubber is visually inoperable.

1.4.2 It the snubber is visually inoperable, NOTIFY the Shift Manager/Unit Supervisor immediately and the Snubber Engineer/Designee. Write a Work Order to REMOVE the snubber to the snubber test facility for a functional test to determine operability.

1.4.3 If the fluid level is above the supply hole for the snubber piston but below 1/2 full in the reservoir, add GE SF 1154 Silicon fluid through the reservoir vent hole until the reservoir is at least 1/2 full.

1.4.4 Examine the snubber for location of leaks. NOTIFY the Snubber Engineer/Designee to take appropriate action.

1.5 PLACE tie wire around the end of the snubber piston rod and an appropriate place on the body of the snubber to restrain the piston rod at the "As-Found" position setting for reinstallation. This wire should be tightened as much as possible.

1.6 REMOVE cotter pin(s) from the end of the clevis pins.

NOTE: Care should be exercised to catch the spacers as the pin or stud is removed.

1.7 USE a chain fall, block and tackle, or similar method to secure and lower the unit for removal as necessary.

1.8 REMOVE the pivot pins from the end attachment and/or pipe attachment, as required.

1.9 ENSURE the snubber setting is not disturbed while unpinning the snubber, if possible.

1.10 TRANSPORT the unit to the designated testing area after it has been decontaminated, if required.

ATTACHMENT 1 (Page 3 of 9)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

2.0 REINSTALLATION OF BERGEN PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

****

CAUTION

Care should be exercised during the reinstallation of the snubber to prevent damage to the piston rod and the accumulator indicator housing.

****

2.1 Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Hydraulic Strut Assembly Installation

NOTES:

(1) The required thread engagement is verified by use of sight holes provided in the coupling. Threads must be visible at these holes to ensure the proper engagement of 1-1/2 times the diameter of the shaft is obtained.

(2) Any required relocation of the strut attachment to clear an interference should be brought to the attention of Site Engineering (Civil).

(3) When installing the threaded adapter, rotate either the adapter or the entire snubber unit to prevent possible scoring of the piston rod cylinder tube. Use the wrench flats provided on the piston rod to hold the rod in place and prevent scoring.

2.1.1 ENGAGE the piston rod in the threaded adapter until it is tight and aligned properly.

2.1.2 BOLT the back end of the unit to the matching rectangular flange of the strut. Use Illustration 2 (Bergen-Paterson, Anchor/Darling, Fronek) or Illustration 4 (Grinnell) for the bolt size, material, and the torque requirements.

2.1.3 CHECK for the required overall pin-to-pin dimension.

2.1.4 USE a chain fall, block and tackle, or similar method to secure and raise the unit for installation as necessary.

2.1.5 ORIENT snubber end attachment and BOLT in place, if required. USE Illustration 2 for torquing requirements or Illustration 4 for tightness. RECORD the torque data on Attachment 4.

2.1.6 INSERT clevis pins in the appropriate clevis.

2.1.7 VERIFY that the cotter pins have been reinstalled in the clevis pins.

ATTACHMENT 1 (Page 4 of 9)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

2.0 REINSTALLATION OF BERGEN PATERSON, ANCHOR/DARLING, FRONEK AND GRINNELL HYDRAULIC SNUBBERS

2.2 Bergen-Paterson, Anchor/Darling, Fronek and Grinnell Structural Mounted Units

NOTE: For units not having struts for adjustment, the method of adjusting the unit is through extension or compression of the piston rod.

2.2.1 CHECK just prior to the installation of the unit that the piston rod is at the "As-Found" position setting or approximately 1 inch less than the "As-Found" position setting as performed in Step 1.2.

NOTE: Due to the internal fluid pressure caused by the spring-loaded piston in the accumulator, the piston rod will slowly extend when not restrained. The minus 1 inch setting will allow for this growth during the time the unit is being reinstalled at its location.

2.2.2 PUSH or PULL on the piston rod, as required, to obtain the proper position setting.

2.2.3 OBTAIN the "As-Left" position setting. RECORD the value on Attachment 4.

2.3 At the end of each installation, CHECK each unit as a precaution for the following information.

- Snubber Serial Number.
- Piston rod extension dimension.
- Fluid level indicator reading.
- Whether or not fluid was added to bring unit to proper level.
- Visible condition of the unit.
- Condition of the strut assembly with particular attention to the clamp and the bolting tightness.
- Cotter pins installed in clevis pins.

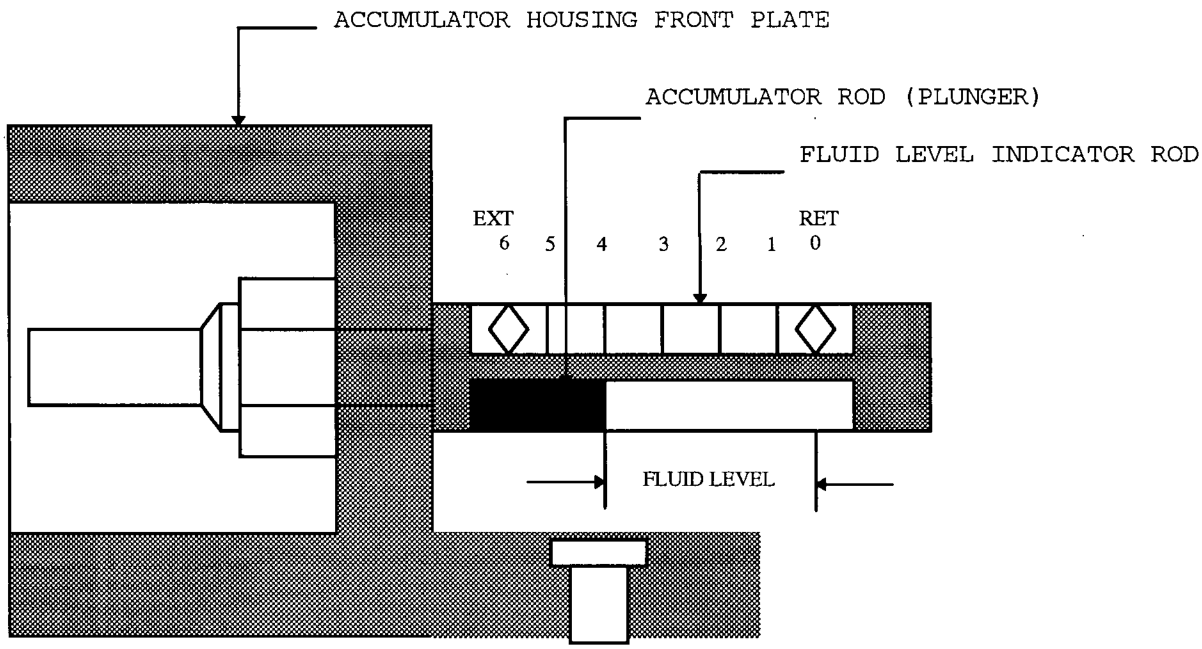
2.4 IF the snubber is subject to moisture, high humidity, or vibration, GREASE the end attachment spherical bearings as required with GP-2 (or equivalent).

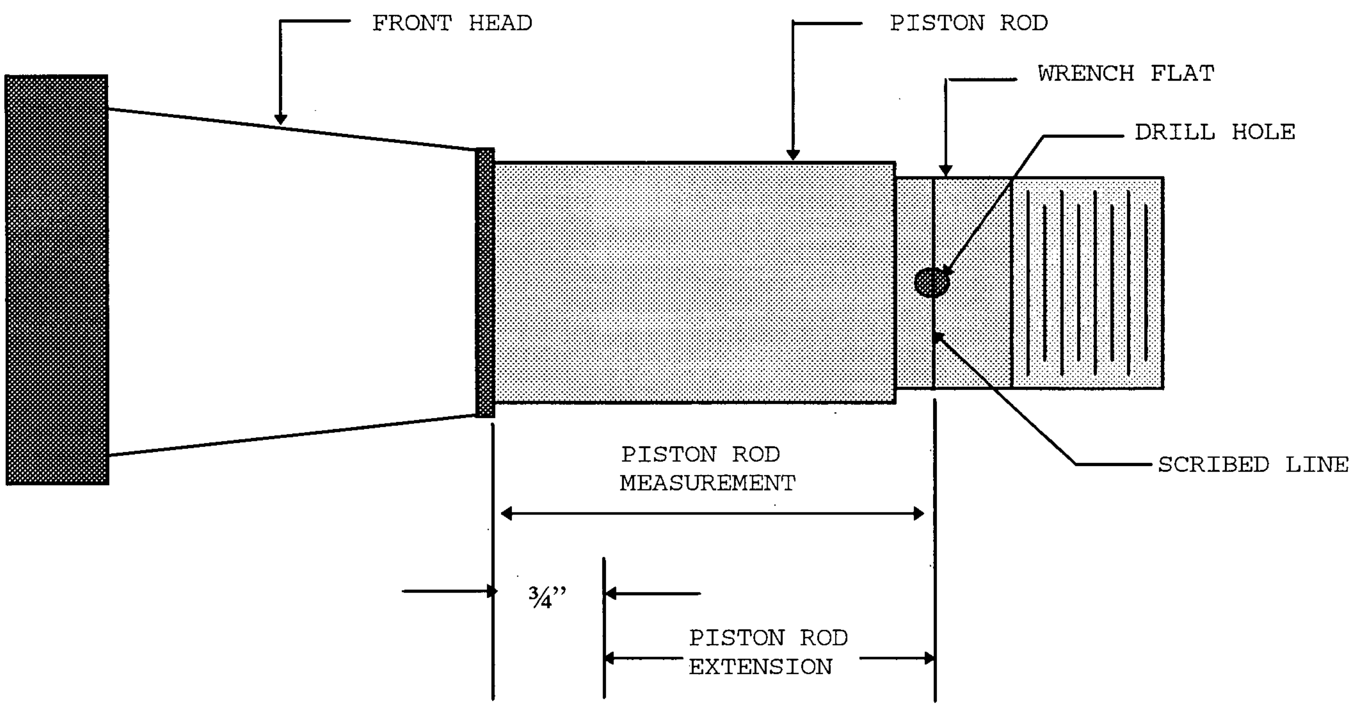
2.5 COMPLETE Attachment 4, and SUBMIT to the Snubber Engineer/designee for final evaluation.

ATTACHMENT 1 (Page 5 of 9)

Illustration 1

BERGEN-PATERSON, ANCHOR/DARLING, FRONEK FLUID LEVEL INDICATOR/PISTON ROD MEASUREMENT





ATTACHMENT 1 (Page 6 of 9)

ILLUSTRATION 2

BERGEN-PATERSON, ANCHOR/DARLING AND FRONEK HYDRAULIC SNUBBER BOLTING GUIDE

Bolting information for mounting flanges on Bergen-Paterson, Anchor/Darling and Fronek Hydraulic snubbers.

Snubber Size	Bolt	Material	Required Torque (1)
HSSA-3	3/8-16	SA307 GR. A	6 FT-LBS
HSSA-10	1/2-13	SA307 GR. A	25 FT-LBS
HSSA-20	5/8-11	SA325	70 FT-LBS
HSSA-30	5/8-11	SA325	100 FT-LBS
ADH-300	3/8-16	SA307 GR. A	6 FT-LBS
ADH-1000	1/2-13	SA307 GR. A	25 FT-LBS
ADH-2000	5/8-11	SA325	70 FT-LBS
ADH-3000	5/8-11	SA325	100 FT-LBS
ADH-5000	7/8-9	SA325	225 FT-LBS
ADH-7000	1-8	SA325	290 FT-LBS
ADH-13000	1-3/8-6	SA325	650 FT-LBS

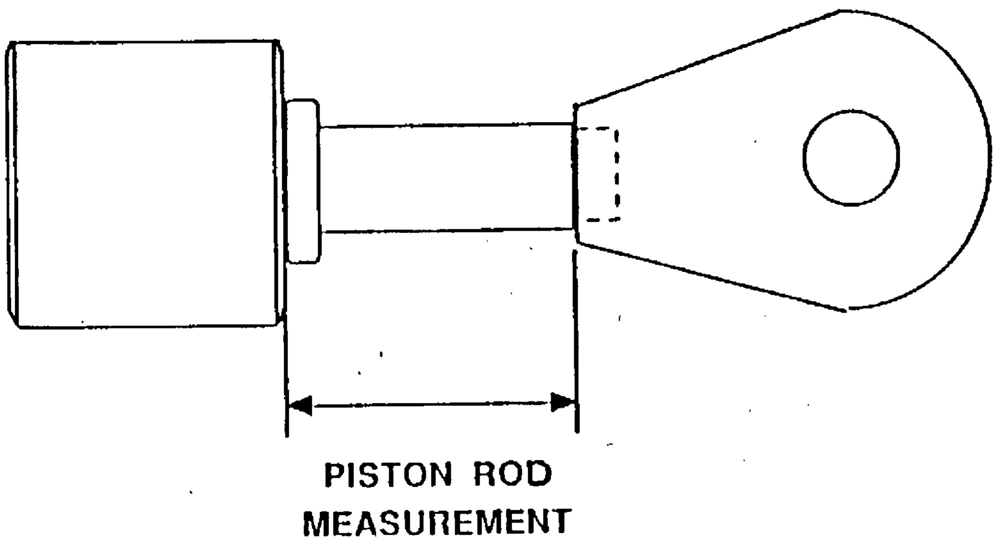
(1) The bolts should be torqued to ± 10 percent of the values shown above.

ATTACHMENT 1 (Page 7 of 9)

GRINNELL HYDRAULIC SNUBBER

ILLUSTRATION 3

PISTON ROD POSITION MEASUREMENT



ATTACHMENT 1 (Page 8 of 9)

ILLUSTRATION 4

GRINNELL HYDRAULIC SNUBBER BOLTING GUIDE

Bolting information for mounting flanges on Grinnell Hydraulic snubbers.

Snubber Size	Bolt	Material	Required Tightness (1)
1-1/2	3/8-24x1-1/4	SA307 GR. A	Snug Tight
2-1/2	3/8-24x1-1/4	SA307 GR. A	Snug Tight
3-1/4	1/2-20x1-1/2	SA307 GR. A	Snug Tight
3-1/2	1/2-20x1-1/2	SA307 GR. A	Snug Tight
4	5/8-18x1-3/4	SA307 GR. A	Snug Tight

(1) The bolts should be tightened snug tight without additional nut rotation.

Snug tight is the condition of tightness that exists when all of the parts of the joint are in firm contact. This tightness may be achieved by an unmodified commercial open-end wrench or a sprocket type ratchet.

ATTACHMENT 1 (Page 9 of 9)

REMARKS:

ATTACHMENT 2
(Page 1 of 5)

REMOVAL AND REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS

NOTES:

(1) The early version of the PSC snubbers was finished with a white epoxy enamel exterior coating. The later version of the snubbers has a zinc-cadmium-chromate stabilized plating.

(2) The standard size of the spherical bearing on the PSA-10 snubbers was changed from 7/8 inch to 1 inch on the later version. However, the later version can be furnished with the 7/8 inch spherical bearing.

(3) Removal/Reinstallation of snubbers is to be performed generally in accordance with the following steps. The steps may be performed out of sequence as required to best facilitate the flow of work.

(4) Document removal and reinstallation data for the snubber on Attachment 4, Removal and Reinstallation of Snubbers.

1.0 REMOVAL OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS

NOTES:

(1) Care should be exercised to catch the spacers as the pin or stud is removed.

(2) The snubbers through size PSA 10 may be easily operated by hand to extend or retract, as necessary, to ease removal of the snubber. For sizes PSA-35 and -100, both pivot pins will require removal, and rigging should be used as necessary to support the snubber.

(3) The foreman should record the diameter of the pivot pin from the PSA-10 snubbers as either 7/8 inch or 1 inch in the remarks section of the Attachment 4, as a reminder when reinstalling the snubber.

(4) When exchanging of an end plug is required on an existing PSA 10 with 7/8 inch diameter pins to a PSA 10 with 1 inch diameter pins, REFER to Attachment 7 for instructions.

1.1 PERFORM visual inspection of the snubber for any visible damage and freedom of movement.

NOTE: IF visible damage or difficulty of movement are discovered, NOTIFY the Snubber Engineer/designee to evaluate the condition in accordance with Attachment 6.

1.2 ENSURE snubber attachment fasteners are not loose or missing prior to unpinning the snubber(s).

NOTE: IF loose or missing attachment fasteners are discovered, NOTIFY Snubber Engineer/Designee to initiate a Problem Event Report (PER) in accordance with SPP-3.1, Corrective Action Program, and evaluate the condition in accordance with Attachment 5.

1.3 MEASURE the "As-Found" position setting in accordance with Illustration 1. RECORD the value on Attachment 4, to the nearest 1/8 inch. The position setting is the measured distance from the housing lip to the edge of the position indicator tube.

ATTACHMENT 2
(Page 2 of 5)

REMOVAL AND REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBER

1.0 REMOVAL OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (Continued)

1.4 REMOVE cotter pin(s) from the end of the clevis pins.

1.5 USE a chain fall, block and tackle, or similar method to secure and lower the unit for removal as necessary.

1.6 REMOVE the pivot pins from the end attachments and/or pipe as required.

1.7 TRANSPORT the unit to the designated testing area after it has been decontaminated, if required.

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS

NOTE: If practical, the snubber should be reinstalled such that the position setting may be read from a convenient location.

2.1 USE a chain fall, block and tackle, or similar method to secure and raise the unit for installation as necessary. CHECK the alignment of the snubber with its rear bracket and/or pipe clamp.

2.2 ENSURE snubbers which are oriented vertically are reinstalled such that the base of the housing assembly is up to avoid accumulation of moisture in the base housing of the snubber.

****

CAUTION

Do not twist or rotate the snubber shaft. Damage to the internal parts will result if the snubber is rotated, one end relative to the other end.

****

2.3 ORIENT snubber end attachment and BOLT in place, if required. USE Illustration 2 for torquing requirements. RECORD the torque data on Attachment 4.

2.3 APPLY anti-seize thread lubricant to the surface of the pivot pins and to all threaded fasteners that are being installed.

2.4 At the end of each installation, CHECK each unit for the following information.

- Snubber Serial Number.
- Piston rod extension dimension.
- Visible condition of the unit.
- Cotter pins installed in clevis pins.
- Gaps between the spacers and the spherical bearing is 1/16 inch or less.

2.5 OBTAIN the "As-Left" position setting. RECORD the value on Attachment 4.

ATTACHMENT 2
(Page 3 of 5)

2.0 REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBERS (Continued)

NOTE: The "As-Left position setting should be the same as the "As-Found" position setting if they are measured identically both times. However, it should be recorded in the remarks section of Attachment 4, if it is different.

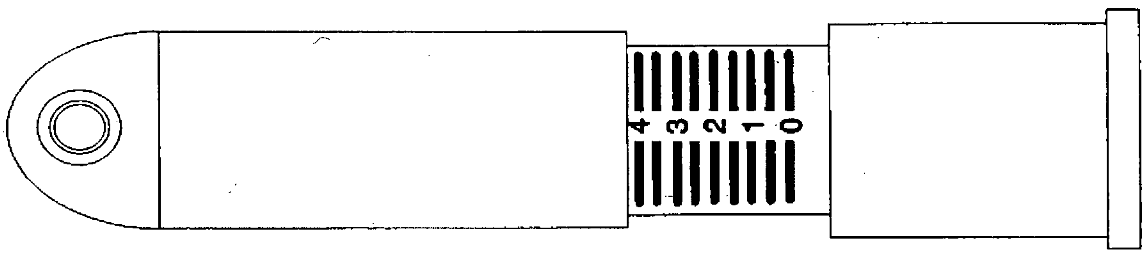
2.6 COMPLETE Attachment 4, and SUBMIT to the Snubber Engineer/Designee for final evaluation.

2.7 IF the snubber is subject to moisture, high humidity, or vibration, GREASE the end attachment spherical bearings as required with GP-2 (or equivalent).

ATTACHMENT 2
(Page 4 of 5)

REMOVAL AND REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBER

ILLUSTRATION 1



ATTACHMENT 2 (Page 5 of 5)

REMOVAL AND REINSTALLATION OF PACIFIC SCIENTIFIC MECHANICAL SNUBBER ILLUSTRATION 2

Size	Spacers (5)	Cotter Pin	Pivot Pin	Stud Bolt (1)
PSA-1/4	1/2 x 3/8 x 1/16	1/8 x 1	3/8 x 2	3/8 x 2, 2-1/4, 2-1/2
PSA-1/2	1/2 x 3/8 x 1/16	3/8 x 1	3/8 x 2	3/8 x 2, 2-1/4, 2-1/2
PSA-1	5/8 x 1/2 x 1/16	1/8 x 1	1/2 x 2	1/2 x 2-3/4, 3, 3-1/4
PSA-3	7/8 x 3/4 x 1/16	1/8 x 1-1/2	3/4 x 2-1/2	3/8 x 4-1/2, 4-3/4, 5
PSA-10	1 x 7/8 x 1/16	3/16 x 2	7/8 x 2-3/4	7/8 x 4, 4-1/4, 4-3/4, 5, 5-1/4, 5-1/2, 6
PSA-35	1-7/8 x 1-1/2 x 3/16	1/4 x 2-3/4	1-1/2 x 4-3/8	1-1/2 x 9-1/4, 9-3/4
PSA-100	2-7/8 x 2-1/2 x 1/2	3/8 x 4	2-1/2 x 7-3/8	2-1/2 x 15-5/8

Size	Stud Nut	Snubber End Attachment Bolts	Indicator Tube Bolts (1)	Snubber End Attachment Bolt Torque
PSA-1/4	3/8- 16 UNC	10 - 24 X 3/4	N/A	22 +/-2 in-lb
PSA-1/2	1/2- 13 UNC	10 - 24 X 3/4	N/A	22 +/-2 in-lb
PSA-1	1/2- 13 UNC	1/4 - 20 X 1	8 - 32 X 1/4	45 +/-5 in-lb
PSA-3	3/4- 13 UNC	5/16- 24 X 1-1/4	10 - 32 X 1/4	120 +/-10in-lb
PSA-10	7/8- 9 UNC	1/2 - 13 X 1-1/2	10 - 32 X 5/16	37 +/-2 ft-lb
PSA-35	1-1/2-6 UNC	N/A	1/2 - 28 X 1/2	N/A
PSA-100	2-1/2-4 UNC	N/A	5/16 -24 X 5/8	N/A

Size	Rod Ext. Nut	Pliers (2)	Safety Wire	Size of Telescope Cylinder	Snap Ring
PSA-1/4	1/2 - 13 UNC	S - 6500	0.032	3/4	N5002 - 200 MD
PSA-1/2	1/2 - 13 UNC	S - 6500	0.032	3/4	N5002 - 200 MD
PSA-1	3/4 - 10 UNC	S - 6700	0.032	1	N5002 - 312 MD
PSA-3	1-1/4 - 7 UNC	S - 6700	0.032	2	N5002 - 412 MD
PSA-10	1-1/2 - 6 UNC	S - 6700	0.032	2-1/2	N5002 - 500 MD
PSA-35	2-1/2 - 4 UNC	N/A	N/A	4	N/A
PSA-100	N/A	N/A	N/A	4	N/A

NOTES:

(1) Head Drilled for lock wire.

(2) Retains support cylinder in housing assembly sizes through PSA 10.

(3) Size of hydraulic snubber which uses the same size attachments.

(4) Browns Ferry has early version with 7/8″ ball bushing and is now special order.

(5) The spaces (A) between the spaces/washers of the bracket assemblies or pipe clamp shall not allow more than 1/16 inch of lateral movement of the spherical.

ATTACHMENT 3 (Page 1 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

NOTE: Document removal and reinstallation data for the snubber on Attachment 4, Removal and Reinstallation of Snubbers. Steps may be performed out of sequence as required to best facilitate the flow of work.

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR)

1.1 PERFORM visual inspection of the snubber visible damage or fluid leakage. RECORD the observed condition on Attachment 4.

NOTE: IF visible damage or fluid leakage are discovered, NOTIFY the Snubber Engineer to evaluate the condition in accordance with Attachment 6.

1.2 ENSURE the visual examination has been performed prior to the removal of the snubber.

1.3 ENSURE snubber attachment fasteners are not loose or missing prior to unpinning the snubber(s).

NOTE: IF loose or missing attachment fasteners are discovered, NOTIFY the Snubber Engineer to initiate a Problem Event Report (PER) in accordance SPP-3.1, Corrective Action Program, and evaluate the condition in accordance with Attachment 5.

1.5 MEASURE the "As-Found" position setting in accordance with Illustration 1A. RECORD the value on Attachment 4, to the nearest 1/8 inch.

NOTES:

(1) For Bergen-Paterson, the piston position setting may be obtained by measuring from the face of the rod head to the beginning of the taper on the rod near the wrench flats and subtracting 1/16 of an inch. See Illustration 1A.

(2) For Lisega, the piston rod extension is the distance(X)from the front head of the snubber to the outside edge marked on piston rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4.

(3) For Lisega, reservoir plunger reading (L) is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch), as shown on Illustration 1B. Record on Attachment 4.

(4) For Lisega, RECORD the "As-Found" position of the 2-way ball valve on Attachment 4.

(5) If the lifting and stroke positioning fixtures are to be used, perform steps 1.6 thru 1.8.

(6) If the lifting and stroke positioning fixtures are not used, perform steps 1.9 thru 1.13.

(7) For testing purposes only the upper pin of the restraint is required to be removed, unless the restraint is required to be completely removed to perform the test.

ATTACHMENT 3 (Page 2 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

1.0 REMOVAL OF BERGEN-PATERSON OR LISEGA HYDRAULIC TORUS DYNAMIC RESTRAINTS (TDR) (Continued)

1.6 POSITION the lifting fixture on the front head by removing the top adjustment bolt and spreading its arms apart.

- CLOSE the fixture's arms around the restraint's front head, making sure the fixture's tabs fit flush against the restraint's front head.
- REPLACE the top adjustment bolt, but do not tighten.

1.7 ASSEMBLE the stroke positioning fixture as shown on Illustration 2, as follows:

- THREAD the Enerpac cylinder into the cylinder mounting bracket, making sure that the Enerpac cylinder has full thread engagement into the mounting bracket.
- CONNECT the hydraulic hoses to the Enerpac cylinder.
- TURN ON the power unit and STROKE the Enerpac cylinder piston rod out 2-1/2 inches from its fully retracted position.

1.8 INSTALL the stroke positioning fixture onto the Torus Dynamic Restraint front clevis per Illustration 3 and the following:

- ATTACH the cylinder/bracket assembly onto the rod clevis round.
- TORQUE the 1-1/4 inch - 7 (cap screw Illustration 3) to 350 FT-LB. The orientation of the cylinder/bracket assembly should be 90 degrees from the perpendicular and in line with the trunnion threaded hole.

NOTE: The lifting fixture may require alignment with the cylinder/bracket assembly to enable the load rod to thread into the trunnion.

- INSERT the load connection rod and THREAD it through the Enerpac threaded collar (Illustration 3).
- TORQUE the top adjustment bolt on the lifting fixture to 50 FT-LBS.

ATTACHMENT 3 (Page 3 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

1.9 ATTACH nylon lifting straps or chokers around the body of the restraint to replace the lifting fixture.

1.10 USE nylon lifting straps or equivalent chokers (no chains) to relieve the restraint's weight from the attachment bracket.

1.11 INSTALL an eye bolt into one of the tapped holes in the locknut.

1.12 ATTACH a safety chain of suitable strength and length from the Come-A-Long or chain fall to one of the tapped holes in the locknut.

1.13 With the Come-A-Long or chain fall, RELIEVE the restraint's weight by pulling upward on the lifting strap(s) with a force of approximately 1500 pounds.

NOTE: If the freeze fit pins have already been removed proceed to step 1.17.

1.14 With the restraint being held in place by the Come-A-Long or chain fall, SET UP the drill rig for the removal of the freeze fit pins.

1.15 DRILL the pin out.

1.16 ENSURE the snubber setting is not disturbed while unpinning the snubber before testing, if possible.

1.17 Removal of the Special 4 Inch Tapered Two Piece Pins:

1.17.1 REMOVE the 1/2 inch cotter pin from the end of the tapered pin and slotted nut.

1.17.2 Using a wrench on the head of the pin to restrain the pin, LOOSEN slotted nut.

1.17.3 BACK OFF the nut until there is approximately 1/2 inch clearance between the washer and the shoulder of the pin.

1.17.4 Using a brass plate or similar device to protect the slotted nut, TAP the brass plate to break loose the self-locking taper of the pin and sleeve; also TAKE CARE not to damage the threads.

1.17.5 REMOVE the slotted nut and washer from the pin and REMOVE the pin from the sleeve.

ATTACHMENT 3 (Page 4 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

****

CAUTION

Do not allow the threads of the pin to contact and gouge the sleeve.

****

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS

NOTES: 1. It is preferred to reinstall the unit in the same restraint assembly, using the identification mark. Using units of similar bore and stroke is possible at any given location, but should be done on a case-by-case basis under the direction of the Snubber Engineer or designee.

2. The permanent spacer washers on the end attachments may be filed smooth in order to facilitate installation of the end piece of the Lisega dynamic restraint.

3. Prior to rigging a Lisega snubber into place verify pin-to-pin dimensions of snubber and attachments to ensure they match and adjust snubber's length as required. For adjustment instructions see steps 2.9.1 thru 2.9.4.

2.1 PERFORM the following:

2.1.1 INSERT the short alignment pin into the torus wall bracket.

2.1.2 INSERT the torus dynamic restraint bottom paddle between the torus wall bracket.

2.1.3 INSERT the special 4 inch tapered two piece pin as directed by step 2.8 into the torus wall bracket.

2.1.4 SWING the front clevis down between the torus bracket ears.

NOTE: If the test machine is attached to the restraint it may be used to adjust the restraint for repining and steps 2.2 thru 2.6 may be skipped.

2.2 CONNECT the hydraulic hoses from the Enerpac power unit to the Enerpac cylinder.

2.3 INSERT the short alignment pin into one of the torus ears (tapered end first).

2.4 TURN the power unit on and EXTEND the restraints' stroke out until the alignment pin slides freely through both the ball bushing and the opposite torus ear.

2.5 Once the temporary pin is inserted, DISCONNECT the hydraulic hoses and UNTHREAD the 1-1/4 inch - 7 UNC load rod from the trunnion until the 1-1/4 inch - 7 UNC screw is accessible.

2.6 REMOVE the cap screw and bracket/cylinder/load rod.

2.7 ASSURE that the restraint is completely restrained.

ATTACHMENT 3 (Page 5 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (Cont.)

2.8 Installation of the Special 4 Inch Tapered Two Piece Pins:

2.8.1 DISASSEMBLE the tapered pin assembly.

2.8.2 APPLY a thin film of lubricant to the OD of the sleeve and to the threads and tapered surface of the pin. USE Never Seez Pure Nickel, Neolube 1 or 2, Felpro C5-A Nuclear Grade, Fel-Pro N-7000 or G.E. Silicone Grease, G-351.

2.8.3 VERIFY the bore of the bracket and the bearing are free of burrs, rust, and debris.

2.8.4 INSERT the tapered pin in the thin end of the sleeve until the threaded portion of the pin is such that the slotted nut can be started.

2.8.5 PLACE a wrench on the pin head to restrain the pin while tightening the slotted nut.

2.8.6 TORQUE BOTH slotted nuts of both special 4 inch tapered two piece pins to 100 FT-LBS. OTHERWISE, TORQUE the upper paddle special 4 inch tapered two piece pin to 100 FT-LBS.

2.8.7 BACK the nut off only enough to align a set of slots in the nut with the first available hole.

2.8.8 INSERT the cotter pin(s) in the hole(s). SPREAD the cotter pin(s) enough to prevent falling out.

2.9 OBTAIN the "As-Left" position setting. RECORD the value on Attachment 4.

NOTES:

(1) For Bergen-Paterson, the piston position setting may be obtained by measuring from the face of the rod head to the beginning of the taper on the rod near the wrench flats and subtracting 1/16 of an inch. See Illustration 1A.

(2) For Lisega, the piston rod extension is the distance(X)from the front head of the snubber to the outside edge marked on piston rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4.

(3) For Lisega, the reservoir plunger reading (L) is the reading from the rear plate to the end of the plunger rod (nearest 1/8 inch), as shown on Illustration 1B: Record on Attachment 4.

(4) If the torus dynamic restraint (Lisega or Bergen-Paterson) piston is at the end of it's stroke it may be necessary to adjust the piston length. This may be performed on the snubber installed in the plant without removing the installation pins. This adjustment is performed under the direction of the Snubber Engineer/Designee utilizing the following steps.

ATTACHMENT 3 (Page 6 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

2.0 REINSTALLATION OF BERGEN-PATERSON OR LISEGA DYNAMIC RESTRAINTS (Cont)

Lisega

2.9.1 LOOSEN the hex head bolts on the end attachment paddle 1-2 turns to allow the piston to be turned.

2.9.2 Using a spanner wrench or other suitable tool, turn the piston clockwise to lengthen the piston or counter clockwise to shorten the piston.

2.9.3 Adjust piston to provide 1/8" to 1/4" of reserve travel as determined by the Snubber Engineer/Designee.

2.9.4 RETIGHTEN the hex head bolts on the end attachment paddle after desired piston adjustment is completed.

Bergen-Paterson

2.9.5 LOOSEN lock nut on the end attachment paddle.

2.9.6 Using an open end wrench, TURN the piston clockwise to lengthen the piston or counter clockwise to shorten the piston.

2.9.7 ADJUST piston as determined by the Snubber Engineer/Designee.

2.9.8 RETIGHTEN the lock nut on the end attachment paddle after desired piston adjustment is completed.

2.10 At the end of each installation, CHECK each unit as a precaution for the following information:

- Snubber Serial Number.
- Piston rod extension dimension.
- Fluid level indicator reading.
- Whether or not fluid was added to bring unit to proper level.
- Visible condition of the unit.
- Condition of the strut assembly, with particular attention to the clamp and bolting tightness.
- Cotter pins installed in clevis pins.

2.11 For Lisega Torus Dynamic Restraints, VERIFY the 2-way ball valve positioner is in the vertical position. RECORD on Attachment 4.

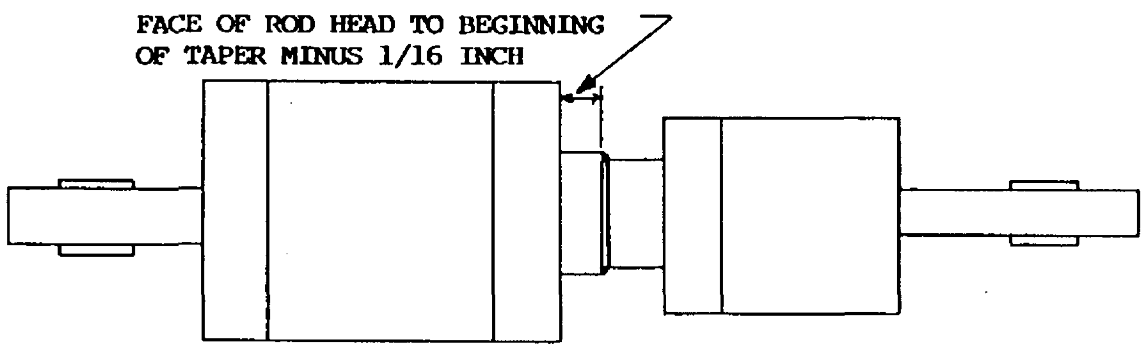
2.12 IF the snubber is subject to moisture, high humidity, or vibration, GREASE the end attachment spherical bearings with a high-quality grease (such as GP-2, etc.) for this application.

2.13 COMPLETE Attachment 4, and SUBMIT to the Snubber Engineer/designee for final evaluation.

ATTACHMENT 3
(Page 7 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

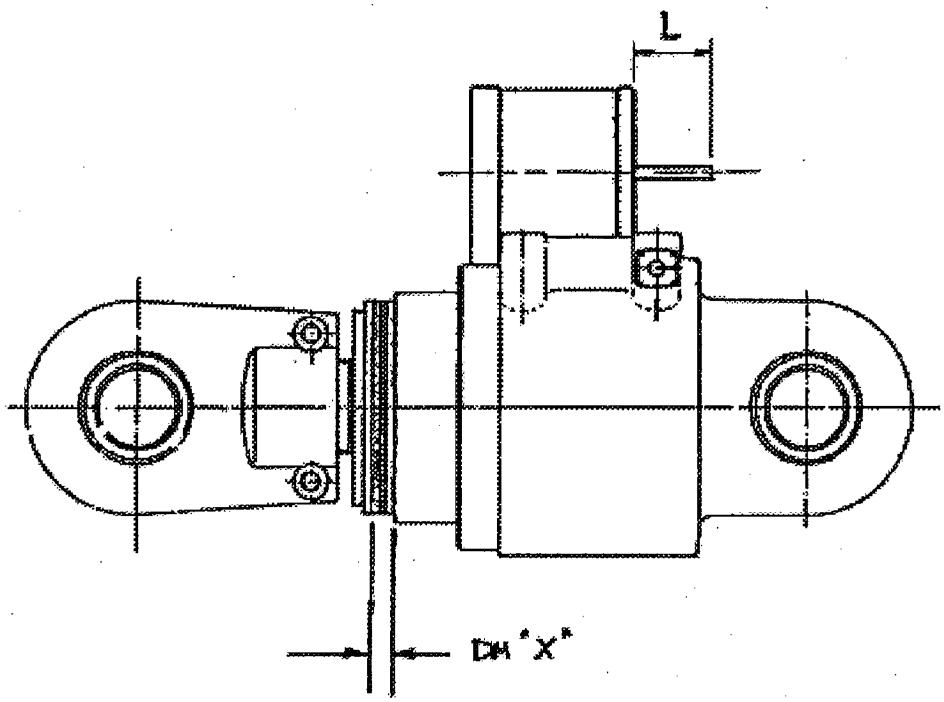
ILLUSTRATION 1A - BERGEN-PATERSON



ATTACHMENT 3
(Page 8 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

ILLUSTRATION 1B - LISEGA



ATTACHMENT 3 (Page 9 of 11)

LISEGA MINIMUM AND MAXIMUM FLUID LEVEL PLUNGER AND PISTON POSITION MEASUREMENT IN THE FIELD

Nomenclature:

X - Measurement of the snubber piston rod position in inches from the front head of the snubber to the outside edge marked piston rod.

L Minimum - The minimum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

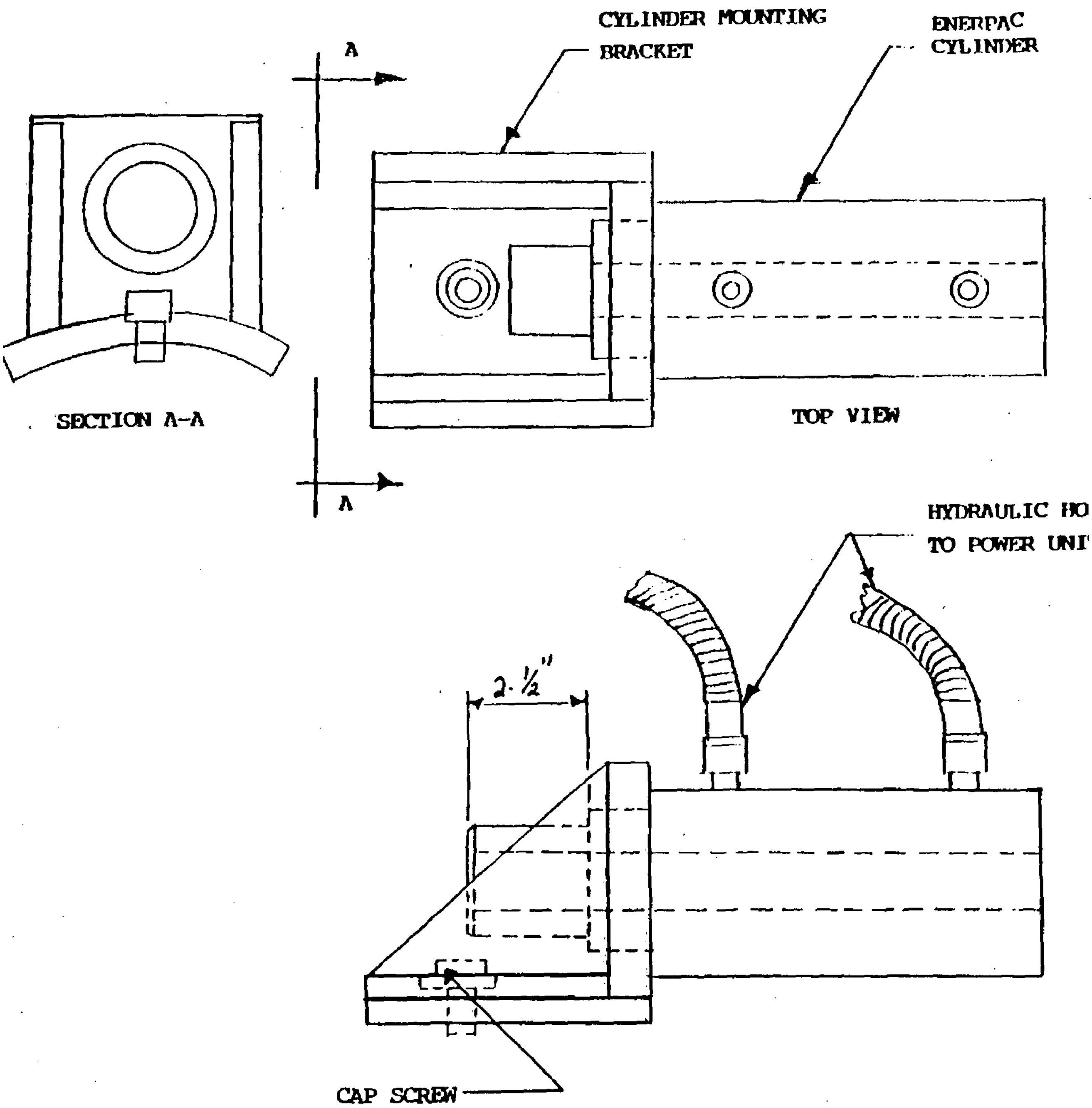
L Maximum - The maximum fluid level in the reservoir using the reservoir piston rod position measured from the front of the reservoir to the end of the reservoir piston rod.

If the X measurement is between the values given in the table below for "X", then go to the next lower reading for "X" to determine the L Minimum and L maximum.

X (INCHES)	L MINIMUM (INCHES)	L MAXIMUM (INCHES)
0.000	2.52	3.31
0.125	2.43	3.22
0.250	2.34	3.13
0.375	2.26	3.04
0.500	2.17	2.96
0.625	2.08	2.87
0.750	1.99	2.78
0.875	1.91	2.69
1.000	1.82	2.60
1.125	1.73	2.52
1.250	1.64	2.42
1.375	1.55	2.34
1.500	1.47	2.25

ATTACHMENT 3
(Page 10 of 11)

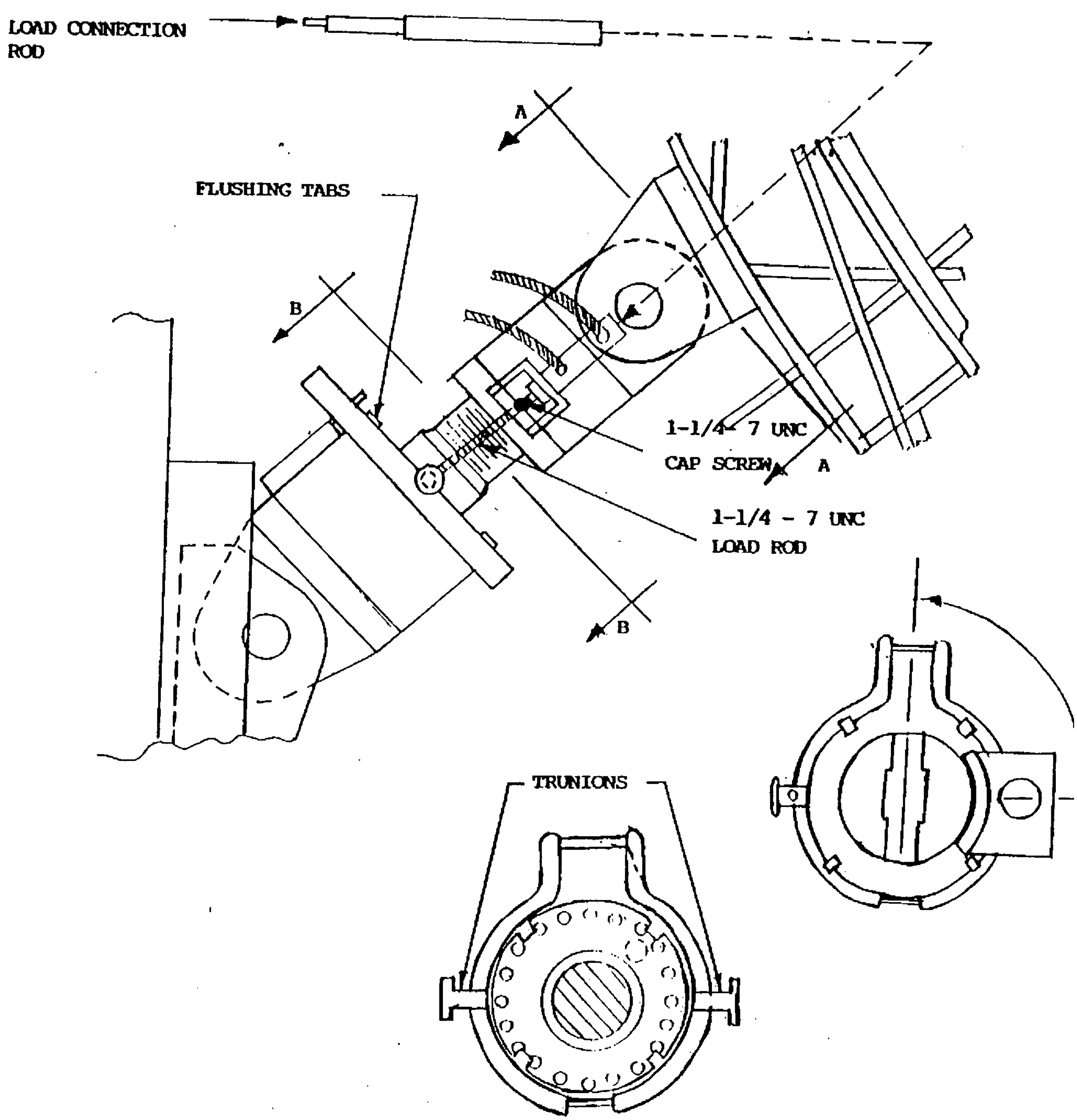
REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS



ATTACHMENT 3
(Page 11 of 11)

REMOVAL AND REINSTALLATION OF BERGEN-PATERSON OR LISEGA TORUS DYNAMIC RESTRAINTS

ILLUSTRATION 3



ATTACHMENT 4 (Page 1 of 3)
REMOVAL AND REINSTALLATION OF SNUBBERS

SNUBBER TYPE: ______________________
Unit _____ Cycle ____ WO # __________________ Snubber UNID # ____________
Snubber S/N ________________ (removed) Snubber S/N ________________ (installed)

Instruction	Performer	Signature/Date
Mechanical Maintenance Snubber Engineer Notified	Foreman/Designee	
Unit Supervisor Notified of Snubber Removal Time_________ Name_________________________	Foreman/Designee	
Visible Damage of Snubber Found: ___YES ___NO	Craftsman	
Fluid Leakage from Snubber Found: ___YES ___NO	Craftsman	
Freedom of Movement for Mechanical Snubber: ___YES ___NO	Craftsman	
Loose or Missing Fasteners: _______ YES _______ NO	Craftsman	
Mechanical Position Indication Reading "As-Found" Reading: _______________	Craftsman	
Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Index / Piston Reading - "As-Found": Record Readings: AF Index(Plunger): ________________ AF Piston :_________ -3/4 = ___________	Craftsman	
Grinnell Hydraulic AF Piston Measurement: _____________ *Fluid Level Acceptable: _____YES _____NO *Reservoir should be approx. half full.	Craftsman	
Bergen-Paterson Torus Dynamic Restraint Index / Piston Reading - "As-Found": Record Readings: AF Index(Plunger): ________________ AF Piston :_________ -1/16 = ___________	Craftsman	
Lisega Torus Dynamic Restraint Piston Rod Position X - "As-Found": Record Reading: _________________	Craftsman	
Lisega Torus Dynamic Restraint Reservoir Plunger L - "As-Found": Record Reading: ______________________	Craftsman	

ATTACHMENT 4 (Page 2 of 3)

REMOVAL AND REINSTALLATION OF SNUBBERS

Instruction	Performer	Signature/Date
Lisega Torus Dynamic Restraint 2-Way Ball Valve - "As-Found": Record Position:________________________	1st/2nd Party	__________/__________
Snap ring seated or Telescoping tube nut torqued Torque Wrench: M&TE No. ____________________ Cal. Due Date __________________	Line Verifier ____________________ Craftsman	____________________
Torque of Base Plate Bolts or Threaded Extension Connector Torque Wrench: M&TE No. ____________________ Cal. Due Date __________________	Line Verifier ____________________ Craftsman	____________________
Fasteners & Pins Secure	Craftsman	
Mechanical Position Indication Reading "As-Left" Reading: _____________	Craftsman	
Bergen-Paterson, Anchor/Darling, Fronek Hydraulic Index / Piston Reading - "As-Left": Record Readings: AL Index(Plunger): ______________ AL Piston :________ -3/4 = __________	Craftsman	
Grinnell Hydraulic AL Piston Measurement: ___________ *Fluid Level Acceptable: ____YES ____NO *Reservoir should be approx. half full.	Craftsman	
Bergen-Paterson Torus Dynamic Restraint Index / Piston Reading - "As-Left": Record Readings: AL Index(Plunger): ______________ AL Piston :________ -1/16 = __________	Craftsman	
Lisega Torus Dynamic Restraint Piston Rod Position X - "As-Left": Record Reading: _______________	Craftsman	
Lisega Torus Dynamic Restraint Reservoir Plunger L - "As-Left": Record Reading: __________________	Craftsman	
Lisega Torus Dynamic Restraint 2-Way Ball Valve - "As-Left": Record Position:________________________	1st/2nd Party	__________/__________

ATTACHMENT 4 (Page 3 of 3)

REMOVAL AND REINSTALLATION OF SNUBBERS

Instruction	Performer	Signature/Date
Index / Piston Reading Acceptable	Craftsman	
Bolts and Jam Nuts Torqued Torque Wrench: M&TE No. ______ Cat. Due Date ______	Line Verifier ______ Craftsman	______
Unit Supervisor Notified Snubber Reinstalled Time______ Name______	Foreman/Designee	

Remarks:______
______

ATTACHMENT 5
(Page 1 of 1)

EVALUATION OF LOOSE OR MISSING ATTACHMENT FASTENERS

This evaluation shall be performed only when fasteners, used for attachment of snubber(s) to component and to snubber anchorage, are discovered loose or missing prior to the "As-Found" functional testing.

SNUBBER TYPE: ____________ Unit ____ Serial No. ______

Snubber UNID No. ____________ PER No. ____________

Subgroup ______ Size ________

1. Describe the discovered condition(s): ____________

2. If possible, determine cause: ____________

3. Evaluate to determine whether the cause may be localized or generic. Use this evaluation to select and list other suspect snubbers for verifying attachment fasteners, as applicable.

4. Describe the corrective action(s) and provide the "As-Found" test results.

Evaluated by: ____________ / ______
SNUBBER ENGR./DESIGNEE DATE

ATTACHMENT 6
(Page 1 of 2)

ENGINEERING EVALUATION OF UNACCEPTABLE INDICATION

Unit ________ Snubber UNID No. ______________ Serial No. ____________

Exam No.______ Manuf. ________________ Size ________ PER No.________________

1. Describe the unacceptable indication(s) observed.

2. What is the cause of the indication(s) (i.e., vibration, water leaking on surface, possible failure to torque at last reinstallation, etc.)?

3. What is the basis for the conclusions reached by question 2 above?

4. Which additional snubbers are suspected to be subject to the same unacceptable indication(s)?

ATTACHMENT 6
(Page 2 of 2)

ENGINEERING EVALUATION OF UNACCEPTABLE INDICATION

Unit ________ Snubber UNID No. ______________ Serial No. ____________

Exam No.______ Manuf. _________________ Size ________ PER No.________________

5. What further examination(s) and/or test(s) of the snubber(s) are to be performed?

____
____
____
____
____
____
____
____

6. What are the results of the examination(s) and/or test(s) performed by Step 5 above, and what changes in the initial evaluation should be made?

____
____
____
____
____
____
____
____

7. What corrective action(s) is/are to be taken for the initial snubber and/or any other suspect snubbers?

____
____
____
____
____
____
____
____

8. Has/have the corrective action(s) been taken? ____________________________

Evaluated by: ________________________/__________
SNUBBER ENGR./DESIGNEE Date

ATTACHMENT 7
(Page 1 of 2)

Instructions for Exchanging the Snubber End Plug

NOTES:

(1) These instructions are applicable to PSA 10 mechanical snubbers.

(2) These instructions are to be followed when an existing PSA 10 mechanical snubber with a 7/8 inch diameter pin is replaced with a PSA 10 mechanical snubber with a 1 inch diameter pin.

1.0 PERFORMANCE

1.1 REMOVE the fillister head screws and flat washers to free the position indicator tube from the end plug assembly of the old and new snubber.

1.2 REPLACE screws if distorted or damaged.

1.3 REMOVE the position indicator tube.

1.4 PLACE the snubber on an appropriate workbench or stand.

1.5 Using an Allen wrench, REMOVE the set screws from the end plug assembly.

1.6 REPLACE screws if distorted or damaged.

1.7 REMOVE the distorted threads of the telescoping cylinder as needed. A drill size number 23 may be used.

- Drill only to the depth necessary to remove the distortions, allowing the end plug to rotate freely.

1.8 SECURE the telescoping cylinder to prevent rotation.

1.9 REMOVE the end plug from each snubber.

1.10 INSTALL the appropriate end plug on the snubber.

1.11 TORQUE the end plug to 40 - 60 inch pounds.

Performer ____________________________/__________
Signature Date

Final torque applied: _______________

Line Verifier _________________________/__________
Signature Date

1.12 COAT set screw threads with approved retaining compound. INSTALL the set screws.

ATTACHMENT 7

(Page 2 of 2)

Instructions for Exchanging the Snubber End Plug

1.13 TORQUE set screws to 15 - 25 inch pounds.

Performer ______________________________/__________
Signature Date

Final torque applied: _______________

Line Verifier _________________________/__________
Signature Date

1.14 REINSTALL the position indicator tube over the end plug assembly.

1.15 COAT fillister screw threads with approved retaining compound. REINSTALL the fillister head screws snug tight. Safety wire fillister head screws.

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM,
THIRD TEN-YEAR INSPECTION INTERVAL

REQUEST FOR RELIEF 3-ISI-2, EXAMINATION AND TESTING OF SNUBBERS

(SEE ATTACHED)

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNIT 3
AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
SECTION XI, INSERVICE INSPECTION (ISI) PROGRAM,
THIRD TEN-YEAR INSPECTION INTERVAL

REQUEST FOR RELIEF 3-ISI-2, EXAMINATION AND TESTING OF SNUBBERS

Executive Summary: Pursuant to 10 CFR 50.55a(a)(3)(i), TVA is requesting relief from the identified ASME Section XI requirements related to examination and testing of snubbers. TVA proposes to continue to use the examination and testing plans currently defined in the BFN Unit 3 Technical Requirements Manual (TR 3.7.4). The current Technical Requirements Manual requirements have been promulgated and approved by NRC, while ASME Section XI imposes overlapping requirements which do not enhance the quality or safety of the subject snubber examination and testing.

Components: Component/piping snubbers

Code Class: 1, 2, and 3

Examination Category: N/A

Item Number: N/A

Code Requirement: 2001 Edition of ASME Section XI with 2003 Addenda

IWF-5300(a) and (b) inservice examination and testing in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988.

IWF-5400 Repairs and Replacements of snubbers shall be in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988.

IWA-6230 requires inservice inspection summary reports for snubbers be filed with the regulatory authority.

IWA-2110 requires Authorized Nuclear Inservice Inspector (ANII) involvement for snubber examination and testing.

Code Requirement From Which Relief is Requested: In accordance with 10 CFR 50.55a(a)(3)(i), relief is requested from the ASME Section XI 2001 Edition, 2003 addenda, requirement for inservice examinations and tests for snubbers, and repair/replacement examinations and tests of snubbers:

a) IWF-5300(a) and (b) inservice examination and testing, and implied OM-1987, Part 4, with OMa-1988, Sections 2.3, Inservice Examination, 2.4, Examination Documentation, and 3.2, Inservice Operability Testing, and 3.3, Testing Documentation.
b) IWF-5400 Repairs and Replacements of snubbers shall be in accordance with the first Addenda to ASME/ANSI OM-1987, Part 4, with OMa-1988, Sections 1.5.6, Snubber Maintenance or Repair, and 1.5.7, Snubber Modification and Replacement
c) IWA-6230, Summary Reports (for snubbers)
d) IWA-2110, Duties of the Inspector (for involvement for snubber examination).

Basis For Relief: ASME Section XI Class 1, 2, and 3 equivalent snubbers are examined and tested in accordance with Browns Ferry Nuclear (BFN) Plant Technical Requirements Manual (TRM), TR 3.7.4. BFN TR 3.7.4 is prepared in accordance with the guidance given by NRC in Generic Letter 90-09. The scope for snubbers examined and tested in accordance with TR 3.7.4 is not limited by line size or other applicable code exemptions and includes a numerically greater population of snubbers than the Section XI program. Examination and testing of the snubbers in accordance with both ASME Section XI and the plant TRM would result in a duplication of effort utilizing different standards and require the preparation of a separate program and associated procedures. This would result in additional cost and unnecessary radiological exposure. In addition, the personnel performing snubber visual examinations would also be required to be certified in accordance with the American Society of Nondestructive Testing (ASNT) SNT-TC-1A "Personnel Qualification and Certification in Nondestructive Testing," and ASME/ASNT-CP-189, which is an additional certification as compared to the task training qualification required to perform the TRM required examinations and testing of snubbers. The existing TRM program for examination and testing of snubbers was promulgated and accepted by NRC.

The implementation of OM-1987, Part 4, with OMa-1988 would require BFN to initiate a snubber examination and testing program that is more complicated and expensive to perform, without a compensating increase in the level of quality and safety.

Alternate Examinations: The BFN Unit 3 TRM, TR 3.7.4, requirements will be utilized for the examination and testing of snubbers for preservice, inservice, and repair/replacement activities. The procedures utilized for these examinations are: 3-SI-4.6.H-1, "Visual Examination of Hydraulic and Mechanical Snubbers;" 0-SI-4.6.H-2A, "Functional Testing of Mechanical Snubbers;" 0-SI-4.6.H-2B, "Functional Testing of Bergen-Paterson, Anchor/Darling, or Fronek Snubbers;" 0-SI-4.6.H-2C, "Functional Testing of Bergen-Paterson Torus Dynamic Restraints;" 0-SI-4.6.H-2E, "Functional Testing of Lisega Large Bore Torus Dynamic Restraint Snubbers;" MPI-0-000-SNB002, "Hydraulic Shock and Sway Arrestor Bergen-Paterson, Anchor/Darling, and Fronek Unit Disassembly and Reassembly;" and MPI-0-000-SNB004, "Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, and Grinnell Hydraulic, and Bergen Paterson, or Lisega Torus Dynamic Restraint Snubbers." This will include the pin-to-pin area inclusive of applicable snubbers.

Testing of repaired and replaced snubbers will also be performed in accordance with TR 3.7.4.

Visual examination of repaired and replaced snubbers will be performed in accordance with MPI-0-000-SNB004, "Removing and Reinstalling Pacific Scientific Mechanical, Bergen-Paterson, Anchor/Darling, Fronek, and Grinnell Hydraulic, and Bergen Paterson, or Lisega Torus Dynamic Restraint Snubbers."

Snubber examination and testing data will be maintained in accordance with the requirements of TR 3.7.4, the site corrective action program, SPP-3.1, and the implementing procedures (3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, MPI-0-000-SNB002, and MPI-0-000-SNB004).

The areas inclusive of the pins back to building structure and to the component/piping being supported will remain in the ASME Section XI examination boundary.

Justification For The Granting Of Relief: The current program, as defined by TR 3.7.4, provides for an acceptable level of quality and safety as that provided by OM Code 1987, Part 4, with OMa-1988.

Examination, testing, repair and replacement of snubbers is currently performed in accordance with TR 3.7.4, which utilizes the guidance provided by NRC in Generic Letter 90-09. The OM Code referenced by ASME Section XI has a different basis for examination (failure mode groups) and testing plans (10, 37, or 55 percent). It is impractical to implement both plans because of the resulting duplication of examination and testing efforts and different requirements for snubber quantities subject to examination or test, actually examined and/or tested, and sample expansion requirements. This would result in additional cost and unnecessary radiological exposure. The differences in the two programs could create confusion when selecting test samples, applying acceptance criteria, corrective actions, and examination schedules for failed snubbers. This situation could increase the possibility of applying the wrong action, thus creating a nonconformance, an in-operability, or even a violation of a TRM requirement.

To eliminate any misinterpretation or confusion in administering overlapping requirements for snubbers, and to remove the possibility of applying contradicting requirements to the same snubber(s), BFN proposes to examine and test snubbers in accordance with BFN Unit 3 TR 3.7.4.

Subarticle IWF-5400 provides the requirements for repair and replacement of snubbers to be in accordance with OM-1987, Part 4. OM-1987, Part 4, Sections 1.5.6, "Snubber Maintenance or Repair" and 1.5.7, "Snubber Modification and Replacement" require repaired and replaced snubbers to meet the visual examination requirements of Paragraph 2.3.1.2 and the operability test requirements of Paragraph 3.2.11. Section 1.5.6 also requires an evaluation of the maintenance or repair activity and Section 1.5.7 requires a suitability evaluation on the replacement/modified snubber. TR 3.7.4 (TSR 3.7.4.6) requires replacement snubbers and snubbers which have repairs which might affect the functional test results to be tested to meet the functional test criteria prior to installation.

Maintenance procedure MPI-0-000-SNB004 provides visual examination criteria for installation of a snubber after repair or replacement. The ASME Section XI repair/replacement program for BFN Unit 3 documents the suitability of repairs/replacements, IWA-4160.

ASME Section XI, VT-3 certification required by personnel performing snubber visual examinations is an additional certification as compared with the TRM program training qualifications. Personnel performing the TRM required visual examinations are "process qualified" to perform the examinations and testing required by the TRM and implemented by the referenced procedures. This training currently includes a visual test associated with face mask fit and specific training on the acceptance criteria associated with procedure MPI-0-000-SNB004. Additional "visual acuity" verification for personnel performing snubber visual examinations will include visual acuity requirements that meet ASME Section XI. The training and documentation of personnel to the visual acceptance criteria, specified in the TRM implementing procedures, provides an acceptable level of quality and safety.

Since relief is sought from the ASME Section XI snubber examination and test requirements, there will be no ASME Section XI snubber examination and test activities to require ANII involvement. The BFN TRM snubber program does not require the use of an ANII for examination and test requirements. The ANII will not be involved in the TRM required visual examination or testing activities performed in lieu of the ASME Code requirements. A snubber program manager provides oversight of the TRM snubber program implementation for both visual examination and functional testing. This oversight includes both review and evaluation of visual examination and functional testing data to ensure TRM requirements are met. The snubber program manager provides an acceptable level of quality and safety without ANII involvement in those activities. ANII involvement in other inservice repair and replacement snubber activities, as required by IWA-2110(g) and (h) and implemented by the BFN ASME Section XI repair and replacement program will be maintained.

Subarticle IWA-6230 and OM-1987, Part 4, Sections 2.3 and 3.3 provide requirements for ASME Section XI inservice examination and test documentation for snubbers and a summary report of examinations and testing. Under the alternate requirements for snubbers, there will be no ASME Section XI inservice examination and testing to document in a summary report. TR 3.7.4 is implemented by surveillance instructions 3-SI-4.6.H-1, 0-SI-4.6.H-2A, 0-SI-4.6.H-2B, 0-SI-4.6.H-2C, 0-SI-4.6.H-2E, and maintenance instruction MPI-0-000-SNB004. These instructions are written and approved in accordance with the TVA Nuclear Quality Assurance Program, includes data sheets for documenting the visual examination and functional test data and results, and provides for documentation of nonconforming results and evaluation of those results. The completed data sheets are QA records and are controlled and maintained in accordance with the BFN QA records program. These records are available onsite for review and inspection. The QA records documenting snubber visual examinations and functional tests provide an acceptable level of quality and safety when compared to the requirements of ASME Section XI and OM-1987, Part 4, with OMa-1988.

Based on the justification provided above, the BFN Unit 3 examination and testing of snubbers program, in accordance with TR 3.7.4, will provide an acceptable level of quality and safety. Therefore, pursuant to 10 CFR 50.55a(a)(3)(i), TVA requests that relief be granted from the 2001 Edition, 2003 addenda of ASME Section XI Code requirements related to inservice examination and testing for snubbers.

Implementation Schedule: TR 3.7.4 will be implemented during the BFN Unit 3 ASME Section XI inservice inspection program for the third ten-year inspection interval for snubber examination and testing in lieu of the ASME Section XI Code requirements listed above.

Reference NRC Safety Evaluation Report (SER) transmitted by letter dated May 3, 1999, for BFN Unit 3 ASME Section XI, second ten-year inservice inspection interval request for relief 3-ISI-2 snubber examination and testing.