



New Snubber Program Owner Training Seminar

Disclaimer

The information contained herein represents the experience and opinions of the presenters. It does not represent an official position or recommendation of the SNUber Users Group (SNUG) and is intended for informational use.

Information pertaining to ASME codes or regulatory positions is presented for historical purposes and any use or interpretations should be verified through those organizations utilizing their approved processes.

Speaker Introductions

Steve Norman

Steve Norman

- 12 Years with Fluor-Daniel at Farley
 - Piping Engineer in construction / Maintenance Engineer in production
- 19 Years with Southern Nuclear at Farley
 - Maintenance Specialist
- Snubber Program Owner at Farley for 21 years
- 2 ½ Years as Welding Engineer at Fort Calhoun
- 1 ½ Years as Pressure Test Coordinator at Palo Verde
- Current Member of ASME Board on Nuclear, Clean Energy, Power, & Facilities Codes & Standards (BNCS)
- Current Member of ASME Strategic Committee on Nuclear Facilities
- Current Chair of ASME Standards Committee on Qualification of Mechanical Equipment (QME)
- Current Vice-Chair of ASME OM Standards Committee (IST)
- Current Member of ASME BPV Code Section XI Standards Committee (ISI)
- Current Chair of ASME OM Subcommittee ISTD
- Current Chair of ASME QME Subcommittee QDR
- Current Chair of ASME BPV XI Working Group Pressure Testing
- Currently employed by Enercon Services, Inc., assigned to Vogtle 3 & 4 as IST & Snubber Programs Engineer

General Info



We will be going through material quickly



Questions are welcome, but in the interest of time, some may be deferred to conference Question & Answer times if time is not available during or after seminar

Purpose of Seminar

- Industry Personnel Turnover Results In
 - Lack of Program Continuity and Consistency
 - Loss of Knowledge and History
 - Loss of "Big Picture" as Focus Shifts to Implementing Established Tasks
- SNUG Board of Directors Approved Seminar(s) to Address These and Other Issues

History of SNUG

- First Meeting December 6, 1984
 - St. Petersburg, Florida
 - 26 Attendees
 - Generic Issue 113
- First Official Conference Summer of 1985 in Charlotte, NC
- Incorporated in 1998
- Annual Winter Working Conference from 1984 until 2020
- Annual Summer Conference & Trade Show from 1985 (held virtually in 2020 & 2021)
- Annual Business Meeting at Summer Conference since 1999

Past Issues

- Generic Issue 113 (NUREG/CR-5416)
- Generic Letter 90-09 Input
- Addressed Information Notices, Bulletins, etc.
 - IN 89-30
 - IN 94-48
- Input to LCO 3.0.8 development

SNUG Documents Available

- White Papers
- Working Group Reports
- Letters
- Other Documents

White Papers

- Alternate Visual Examinations
- End Attachment Gaps
- Vibration and Fretting Corrosion
- Drag Testing of Mechanical Snubbers
- Beyond Design Basis Events

Disclaimer with each White Paper:

THIS DOCUMENT HAS BEEN DEVELOPED BY THE SNUBBER USERS GROUP (SNUG) FOR USE BY ITS MEMBERSHIP. THIS INFORMATION IS REPRESENTATIVE OF THE GENERAL CONSENSUS OF THE SNUG, BUT MAY NOT REPRESENT THE OPINIONS OF ALL OF THE SNUG MEMBERSHIP. NO PART OF THIS DOCUMENT SHOULD BE CONSIDERED AS MANDATORY POLICY THAT MUST BE ADHERED TO BY ANY SNUG MEMBER.

Other Documents

- Lubrication Working Group Report
- Program Document Template
- Program Assessment Guide (workshop provided on use of guide)
- Letter to NRC Reply to IN 94-48

Manuals

- Seal Life Manual
- Hydraulic Snubber Manual
- Mechanical Snubber Manual

Seminar Objectives

- Focus on 'Big Picture'
 - Primarily Addresses Generic Program Scope and Basis Issues
 - Snubber Specific Technical Issues to be Addressed in More Specific Seminars
- Provide History of Program Requirements
 - Evolution of Requirements
 - Basis of Original Requirements
- Provide Overview of Current Program Requirements
 - Outline Current Requirements
 - Governing Documents / Licensing Basis for Current Requirements
 - Compare / Contrast Various Basis Requirements
 - Interaction of Codes & Regulations

History of Snubber Program Requirements

- Plants built in the 1960's and early 1970's had no testing, examination or service life monitoring requirements for snubbers.
- Snubber supports were treated the same as variable spring supports or constant load supports.
- Snubber supports were included in the ISI program along with all other types of supports.
- Most snubber populations were primarily hydraulic at that time and most hydraulics had external tubing.
- Snubbers began exhibiting problems associated with hydraulic fluid leaks, mostly occurring at tubing fittings or with lexan reservoirs cracking.

History of Snubber Program Requirements

- First NRC requirements issued early to mid 1970's
 - Developed because of experiences with snubbers in service
 - Hydraulic snubber seals
 - Failure to lock-up
 - IEB 73-03: Defective Hydraulic Shock Suppressors and Restraints
 - IEB 73-04: Defective Bergen-Paterson Hydraulic Shock Absorbers
 - IEB 75-05: Operability of Category I Hydraulic Shock and Sway Suppressors
 - IEB 78-10: Bergen-Paterson Hydraulic Shock Suppressor Accumulator Spring Coils

History of Snubber Program Requirements (Cont.)

- Early Technical Specifications
 - NUREG-371 Recommendations
 - Development of Technical Specification
 - Standard Review Plan (SRP) Revision
 - Regulatory Guides
 - 1980 - Revision to Standard Tech Specs 3/4.7.9 (Snubbers)
 - 1981 – Revision to SRP 3.9.3

History of Snubber Examination & Testing Requirements (Cont.)

- Early Technical Specifications
 - Initial Tech Specs applied only to hydraulics
 - Included both visual examination and functional test requirements
 - 100% visuals at least once every 18 months
 - » As often as every month depending upon number of failures
 - » Every month if seal material is not proven
 - Testing applied to 50 Kip and smaller
 - » Lock-up, bleed, and FOM (In-service Drag) tests required
 - » 10 snubbers or 10% (smaller of two) each outage
 - » Supplemental samples of equal size tested for each failure

Typical Snubber Tech Spec Visual Table from 1980's

SURVEILLANCE REQUIREMENTS

4.7.9 Each snubber shall be demonstrated OPERABLE by performance of the following augmented inservice inspection program and the requirements of Specification 4.0.5.

a. Visual Inspections

The first inservice visual inspection of snubbers shall be performed after four months but within 10 months of POWER OPERATION and shall include all snubbers within the scope of Specification 3.7.9. If less than two (2) snubbers are found inoperable during the first inservice visual inspection, the second inservice visual inspection shall be performed 12 months $\pm$ 25% from the date of the first inspection. Otherwise, subsequent visual inspections shall be performed in accordance with the following schedule:

<u>No. Inoperable Snubbers per Inspection Period</u>	<u>Subsequent Visual Inspection Period*#</u>
0	18 months $\pm$ 25%
1	12 months $\pm$ 25%
2	6 months $\pm$ 25%
3,4	124 days $\pm$ 25%
5, 6, 7	62 days $\pm$ 25%
8 or more	31 days $\pm$ 25%

The snubbers may be categorized into two groups: Those accessible and those inaccessible during reactor operation. Each group may be inspected independently in accordance with the above schedule.

History of Snubber Program Requirements (cont.)

- NRC Revised Requirements
 - 1980, 1984 Generic Letters addressed revised Tech Spec requirements
 - Primarily formed basis for most "Original" Tech Specs (Pre-ITS)
 - All sizes included
 - Categorization of snubbers by design
 - In-service drag test requirements for hydraulic snubbers removed
 - Various sample plans offered
 - Generic Letter 80-99 revised TS and added requirements for mechanical snubbers
 - Activation and drag tests required
 - Freedom of Motion Tests
 - 1981 – IE 81-01 addressed “frozen” INS mechanical snubbers
 - Generic Letter 84-13 eliminated snubber list from Tech Specs

Typical Tech Spec Snubber List

TABLE 3.7-4a

SAFETY RELATED HYDRAULIC SNUBBERS*

<u>SNUBBER NO.</u>	<u>SYSTEM SNUBBER INSTALLED ON, LOCATION AND ELEVATION</u>	<u>ACCESSIBLE OR INACCESSIBLE (A or I)</u>	<u>HIGH RADIATION ZONE DURING SHUTDOWN** (Yes or No)</u>	<u>ESPECIALLY DIFFICULT TO REMOVE (Yes or No)</u>
2MS-R534	Aux. Bldg., E1. 179'-7-3/16" Col. Lines T15 & T16 TA & TA	A	No	Yes
2MS-R532#	Aux. Bldg., E1. 155'-7-3/8" Col. Lines TA & A 31 & 34	A	No	Yes
2MS-R533	Aux. Bldg., E1. 155'-7-3/8" Col. Lines TA & A 31 & 34	A	No	Yes
2MS-R517	Aux. Bldg., E1. 130'-2" Col. Lines C & D 34 & 36	A	No	Yes
2MS-R516#	Aux. Bldg., E1. 130'-2" Col. Lines C & D 34 & 36	A	No	Yes
2MS-R503#	Aux. Bldg., E1. 130'-2" Col. Lines C & D 31 & 34	A	No	Yes
2MS-R505	Aux. Bldg., E1. 130'-2" Col. Lines C & D 31 & 34	A	No	Yes
2MS-R510	Aux. Bldg., E1. 130'-2" Col. Lines C & D 31 & 34	A	No	Yes
2MS-R522	Aux. Bldg., E1. 147'-0-11/16" Col. Lines A & B 31 & 34	A	No	Yes

Snubber List Commitment

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATED TO AMENDMENT NO. 55 TO FACILITY OPERATING LICENSE NO. NPF-2

AND AMENDMENT NO. 46 TO FACILITY OPERATING LICENSE NO. NPF-8

ALABAMA POWER COMPANY

JOSEPH M. FARLEY NUCLEAR PLANT, UNIT NOS. 1 AND 2

DOCKET NOS. 50-348 AND 50-364

Introduction

Alabama Power Company (APCo) by letter dated July 6, 1984, requested amendments to the Farley Units 1 and 2 Technical Specifications (TSs). The proposed amendments consist of revisions to the snubber Technical Specifications (Section 3/4.7.9) pursuant to NRC Generic Letter 84-13 and miscellaneous administrative changes to other sections of the Technical Specifications. Our evaluation follows.

Evaluation

The licensee proposed to delete Tables 3.7-4a and 3.7-4b from the Units 1 and 2 Technical Specifications. Deletion of these tables, which list safety-related snubbers, will eliminate the need for frequent TS amendments to incorporate changes in the snubber listings. This change is in accordance with guidance issued to all licensees in NRC Generic Letter 84-13, dated May 3, 1984, Subject: Technical Specification for Snubber (Generic Letter 84-13). The licensee will maintain the listing of safety-related snubbers in the plant surveillance procedures. Changes to these lists are subject to the provisions of 10 CFR 50.59.

History of Snubber Program Requirements (cont.)

- Section XI
 - 1978 ASME Section XI IWF-5000 introduced (Winter addenda)
 - Small bore only (< 50 kips)
 - 10% testing only, representative
 - Rotate through population
 - 1982 NRC Rulemaking endorsed Section XI for first time
 - 1987 Addenda
 - added reference to OM Part 4 (in preparation)
 - Added examinations (referenced VT-3, IWA-2213)
 - Added attachments
 - Dropped size limit
 - Removed test and sample details
 - 1989 Incorporated dates (OM-1987 published in 1988)
 - 1992 Removed OM publication dates
 - 2006 Addenda deleted snubbers from ISI

Section XI Article IWF

SUBSECTION IWF REQUIREMENTS FOR CLASS 1, 2, 3, AND MC COMPONENT SUPPORTS OF LIGHT-WATER-COOLED PLANTS

ARTICLE IWF-1000 SCOPE AND RESPONSIBILITY

IWF-1100 SCOPE

This Subsection provides the requirements for inservice inspection of Class 1, 2, 3, and MC component supports.

IWF-1200 COMPONENT SUPPORTS SUBJECT TO EXAMINATION AND TEST

IWF-1210 EXAMINATION REQUIREMENTS

The examination requirements shall apply to the following:

- (a) piping supports
- (b) supports other than piping supports

IWF-1220 SNUBBER INSPECTION REQUIREMENTS⁴⁰

The inservice inspection requirements for snubbers are outside the scope of this Division.

IWF-1230 SUPPORTS EXEMPT FROM EXAMINATION

Supports exempt from the examination requirements of [Article IWF-2000](#) are those connected to piping and other items exempted from volumetric, surface, or VT-1 or VT-3 or general visual examination by [IWB-1220\(a\)](#) through [IWB-1220\(c\)](#); [IWC-1221](#), [IWC-1222](#); [IWD-1220\(a\)](#) through [IWD-1220\(d\)](#); and [IWE-1220\(a\)](#), [IWE-1220\(c\)](#), and [IWE-1220\(d\)](#). In addition, portions of supports that are inaccessible by being encased in

concrete, buried underground, or encapsulated by guard pipe are also exempt from the examination requirements of [Article IWF-2000](#).

IWF-1300 SUPPORT EXAMINATION BOUNDARIES

The support examination boundaries for both integral and nonintegral supports are shown in [Figure IWF-1300-1](#). The following definitions apply.

(a) The boundary of an integral support (B) connected to a pressure-retaining component (A) is the distance from the pressure-retaining component (A) as indicated in [Subsection IWB](#), [Subsection IWC](#), [Subsection IWD](#), and [Subsection IWE](#).

(b) The boundary of an integral support (C) connected to a building structure (E) is the surface of the building structure.

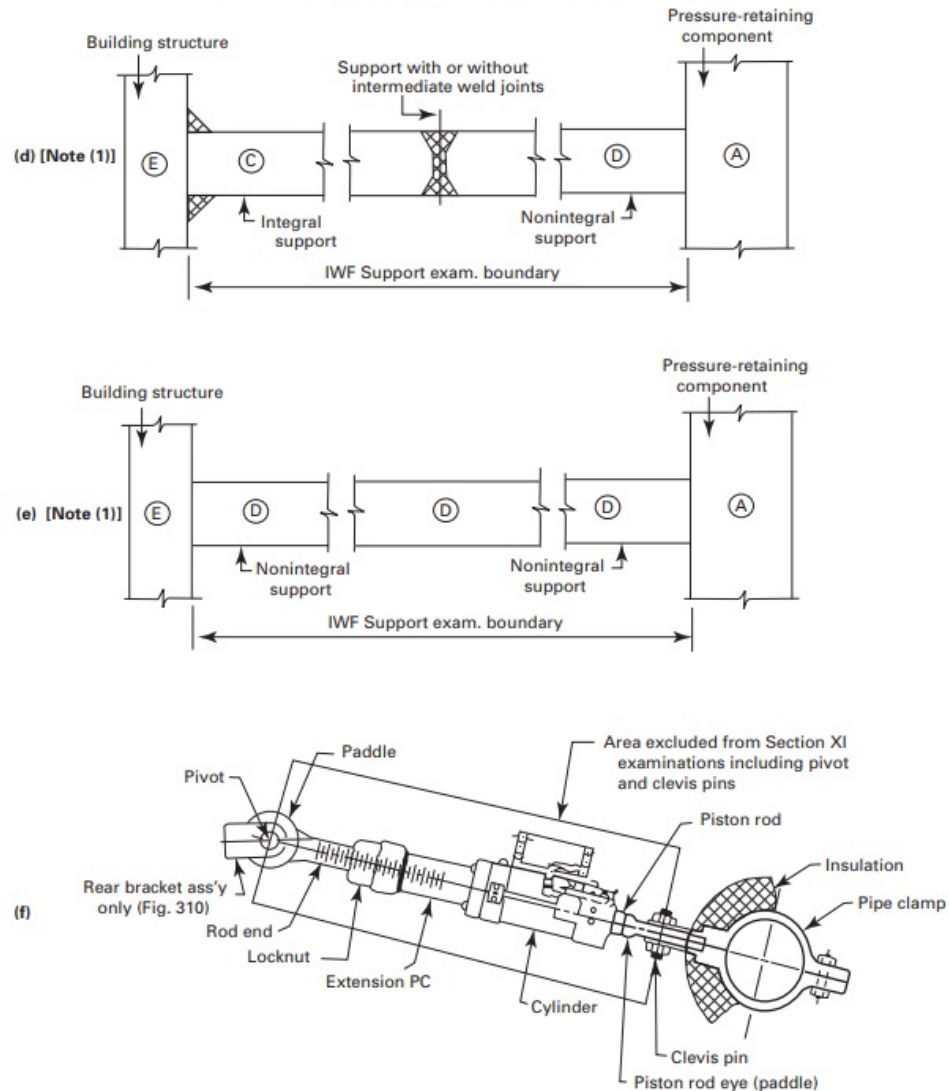
(c) The boundary of a nonintegral support (D) connected to a pressure-retaining component (A) is the contact surface between the component and the support.

(d) The boundary of a nonintegral support (D) connected to a building structure (E) is the surface of the building structure.

(e) Where the mechanical connection of a nonintegral support is buried within the component insulation, the support boundary may extend from the surface of the component insulation, provided the support is under continuous tension or compression load.

Section XI Figure IWF-1300-1

Figure IWF-1300-1
Illustrations of Typical Support Examination Boundaries (Cont'd)



History of Snubber Program Requirements (cont.)

- ASME OM-4 / ISTD
 - Working Group formed in late 1970's
 - Tasked to develop pre-service and in-service snubber examination requirements (OM Part 4)
 - OM Part 4 issued as OMA-1988 addenda to 1987 OM Code
 - Eventually became Subsection ISTD of OM-1990
 - Two Test Plans
 - 10% Plan
 - 37 Plan

History of Snubber Program Requirements (cont.)

- Improved Technical Specifications
 - Improved Tech Specs (ITS) mid - late 90's
 - Relocated snubbers to Owner Controlled Documents (TRMs)
 - Requirements unchanged (cut & paste from Tech Spec to Owner Controlled Document)
 - Changes per 10CFR50.59 possible
 - LCO for snubbers was lost for most sites

History of Snubber Program Requirements (cont.)

Comparison of Early Tech Specs / Later Tech Specs / Section XI / OM Code

The tables on the following slides will provide a comparison of the following topics over several program guidance documents:

- Scope
- Examination Boundary
- Personnel Certifications
- Test Plans
- Failure Mode Grouping
- Drag Testing
- Service Life Monitoring

Scope Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI IWF (1978- 1987a)	Section XI IWF (1987a-2006)	OM-4 (1988)	ISTD (ISTA) (1990)
All Safety Related Hydraulic Snubbers	All Safety Related Snubbers + Snubbers Affecting SR Systems	Class 1, 2, 3, & MC Snubbers with Load ratings < 50 kips <u>Testing Only</u>	Class 1, 2, 3, & MC Snubbers <u>Added Examinations</u>	All Safety Related Snubbers	RC Pressure Boundary, Achieve or Maintain Safe Shutdown, Mitigate Accident

Boundary Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI IWF (1978- 1987a)	Section XI IWF (1987a- 2006)	Section XI IWF (2006)	OM-4 (1988)	ISTD (1990)
Pipe to Building Structure	Pipe to Building Structure	Pipe to Building Structure	Refers to OM-4	Excludes snubber Pin to Pin	Pipe to Building Structure	Pin to Pin

Certification Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI IWF (1987a)	OM-4 (1988)	ISTD (1990)
None	None	VT-3 Method required	Per Owner's Reqs.	Per Owner's Reqs

Test Plan Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI IWF (1978a)	Section XI IWF (1987)	OM-4 (1988)	ISTD (1990)
10% or 10 No FMG	10%, 37 (others, 88,55,etc) No FMG	10% No FMG	Refers to OM-4 (pointer removed in 2006 Addenda)	10%, 37 Mandatory FMG	10%, 37 Optional FMG

Drag Test Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI (1978a)	Section XI (1987)	OM-4 (1988)	ISTD (1990)
Hyd. Breakaway & Running	Mech. Breakaway & Running	Hyd.&Mech Breakaway & Running	Refers to OM-4 (pointer removed in 2006 Addenda)	Mech. Breakaway & Running	Mech. Running

Service Life Comparisons

Early TS (1980)	Later TS (TRMs) (1994)	Section XI (< 1987)	Section XI (1987)	OM-4 (1988)	ISTD (1990)
None	Yes	None	Refers to OM-4 (pointer removed in 2006 Addenda)	None	Yes

Current Requirements

- General Program Requirements Today
 - Visual Examination
 - Functional Testing
 - Service Life Monitoring
 - Documentation
 - Maintain Listing of Snubbers
 - Maintain Service Life data
 - Design/Licensing Basis of Program (site specific)
 - Implementation (actions taken)
 - NUREG 1482 Appendix A addresses Program requirements

Current Requirements

- Applicable Site-Specific Licensing Basis for Requirements
 - Technical Specifications (in some cases LCOs only)
 - Owner Controlled Documents (TRMs)
 - Section XI (Prior to 2006 addenda)
 - OM-4 (none currently)
 - ISTD
 - Relief Requests
- Reconciliation of Multiple Basis Documents
 - Must define ALL governing requirements for the Program
 - If Tech Specs/TRM do not match the governing Code then both sets of requirements must be satisfied
 - If applicable, Section XI requirements must be met unless relief is granted

Current Requirements (cont.)

— Recent & Future Changes

- Section XI Article IWF-5000 Deleted in 2006 Addenda
- Subsequent to 2006a all Snubber In-Service Requirements to be in accordance with OM ISTD
- **NRC rulemaking requires ISTD if using SC XI 2006 addenda or later**
- Any exception requires an approved Relief Request
- Must update TS/TRM/Commitments/Procedures to incorporate or reference OM ISTA and ISTD.

Historic Reference Documents

- There are many historical documents that drove the evolution of snubber examination, testing, and service life requirements to current practices.
- NRC, manufacturers, INPO, EPRI, etc.
- Some provide good background information; others simply show the early industry lack of understanding.
- Many are readily available, others not so much.
- The list provided is not all inclusive but meant to convey the long history and depth of input that got us where we are today – both the good and the bad.

NRC Generic Letters & Bulletins

Generic Letters

GL 80-99, Surveillance Requirements for Mechanical Snubbers

GL-84-13, Technical Specification For Snubbers

GL-89-09, ASME Section III Component Replacements

GL 90-09, Visual Inspection Frequency

GL 91-18, Operability Guidelines

Bulletins

B73-03, Defective Hydraulic Shock Suppressors

B73-04, Defective Bergen Paterson Hydraulic Shock Suppressors

B75-05, Operability of Hydraulic Shock Suppressors

B78-10, Bergen-Paterson Hydraulic Shock Suppressor Accumulator
Spring Coils

B79-02, Pipe Support Anchor Bolts

B79-14, Configuration Verification

B81-01, Failures/Surveillance of Mechanical Snubbers

NRC Information Notices

N79-01, Bergen-Paterson Hydraulic Shock Arrestors

N79-05, Improper Materials in Safety Related Components

N80-42, Radiation Effects on Hydraulic Snubber Fluid

N82-12, Failure/Surveillance of Hydraulic Snubbers

N83-13, Misapplication of Bergen-Paterson Clamp

N83-20, ITT-G Fig. 306/307 Mechanical Snubber Attachment Interference

N83-47, Failure of Hydraulic Snubbers

N84-67, Recent Snubber Testing High Failure Rate

N84-73, Down Rating of Self Aligning Ball Bushings

N86-102, Repeated Multiple Failures of SG Snubbers

N88-95, Inadequate Validation of Procured Parts for Anchor/Darling
Mechanical Snubbers

NRC Information Notices

N89-30, High Temperature Environment

N94-48, High Temperature Environment

N95-09, Use of Inappropriate Guidelines/Criteria for Operability
Evaluations of Pipe and Supports

N97-16, Pre-conditioning of Components Prior to IST

N97-71, Inappropriate Use of 50.59 Regarding Reduced Seismic
Criteria for Temporary Conditions

NRC RIS & EGM

RIS 2010-06, Inservice Inspection and Testing Requirements of
Dynamic Restraints (Snubbers)

EGM 10-001, Enforcement Guidance Memorandum, Dispositioning
Violations for Inservice Examination and Testing
Requirements for Dynamic Restraints (Snubbers)

NRC Circulars

C76-05, Bleed and Lock-up Velocities on ITT-Grinnell Figure 200 and 201 Hydraulic Shock Suppressors

C78-07, Damaged Components of Bergen-Paterson Series 25000 Test Stand

C79-25, Bergen-Paterson Shock Arrestor Strut Assembly Interference

C81-05, Self-Aligning Rod End Bushings for Pipe Supports

NRC NUREGs

NUREG-371

NUREG-933

NUREG-1482

CR-2175, Snubber Sensitivity Study

CR-2032, Single Vs. Dual Snubber Installations

CR-2136, Effects of Postulated Event Devices on Normal Operation of Piping Systems in Nuclear Power Plants

CR-4279, Aging and Service Wear of Hydraulic and Mechanical Snubbers Used on Safety-Related Piping and Components of Nuclear Power Plants

CR-5386, Basis for Snubber Aging Research

CR-5416, Generic Issue 113, Dynamic Qualification and Testing of Large Bore Hydraulic Snubbers

CR-5646, Piping System Response During High Level Simulated Seismic test at the Heissdampfreaktor Facility (SHAM Test Facility)

CR-5870, Results of LWR Snubber Aging Research

CR-6027, Evaluation of Snubber Single Failures

EPRI Documents

NP-2297	Snubber Reliability Improvement Study
NP-5854	Assessing the Costs, Risks, and Benefits of Snubber Reduction: A Comprehensive Framework (June 1988).
NP-6443	Improved Criteria for Snubber Functional Testing, July 1989.
NSAC-104	Guidelines for Reducing Snubbers on Nuclear Piping Systems
TR-1010968	Tier 2, Volume 1, Guidelines and Criteria for Nuclear Piping and Support Evaluation and Design, Integration of Methods and Guidelines to Evaluate Nuclear Piping and Pipe Support Design and Operability Issues. (Not NRC endorsed)
TR-1010968	Tier 2, Volume 4, Guidelines and Criteria for Nuclear Piping and Support Evaluation and Design, Behavior and Failure Mode of Standard Pipe Supports Beyond Their Design Conditions
TR-102363	Tier 1 & 2, Evaluation of Snubber Functional Test Methods.
TR-6270-1	Snubber Reduction Program (October 1985)

INPO Documents

86-014, Good Practice MA-313, “Snubber Maintenance Program”
(never formally approved)

OMRs (Operations and Maintenance Reminders)

- OMR-19, Grinnell Snubber Orientation
- OMR-20, Corroded INS Mechanical Snubbers
- OMR-38, Grinnell Snubber Orientation
- OMR-83, ITT Grinnell Hydraulic Snubbers
- OMR-115, Steam Generator Snubber Failures
- OMR-146, Failure of PSA Mechanical Snubbers
- OMR-223, Waterhammer in RHR System Damages Snubber
- OMR-310, Aux. Feedwater Pump Trip

SERs (Significant Event Reports)

- SER22-81, Corrosion Failure of Mechanical Snubbers
- SER54-81, ECCS Piping Damaged
- SER90-81, High Occurrence of Degraded Hydraulic Snubbers

Technical Reports

- Combustion Engineering Report 82-02,
Installation of Grinnell Hydraulic Snubbers
- General Electric Report SIL021,
Seals for Bergen-Paterson Hydraulic Shock Suppressors
- General Electric Report SIL021S1,
Seals for Bergen-Paterson Hydraulic Shock Suppressors
- General Electric Report SIL021S2,
Seals for Bergen-Paterson Hydraulic Shock Suppressors
- General Electric Report SIL021S3,
Seals for Bergen-Paterson Hydraulic Shock Suppressors
- General Electric Report SIL021S4,
Snubber Surveillance Program
- General Electric Report SIL021S5,
Seals for Grinnell Hydraulic Shock Suppressors
- General Electric Report SIL070,
Hydraulic Shock Suppressor Application
- General Electric Report SIL339,
Mechanically Locked Snubbers



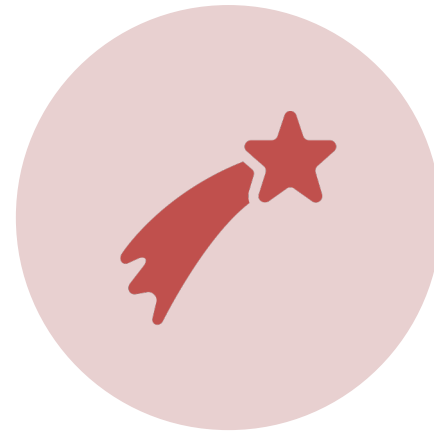
QUESTIONS?



COMMENTS?



THANK YOU FOR YOUR TIME.



WE HOPE YOU HAVE LEARNED
SOMETHING TODAY.

MORNING BEVERAGE BREAK
SPONSORED BY



RETURN BY 10:30 AM



S N U B B E R U S E R S G R O U P

**Late Registration is Open
Session will start at 10:30 AM**

PLEDGE OF ALLEGIANCE

Before we call the conference to order,
please join us in the Pledge of Allegiance
to the American Flag.





S N U B B E R U S E R S G R O U P

SNUBBER USERS GROUP 2024 SUMMER CONFERENCE & TRADE SHOW

Call To Order
Scott Esposito

WELCOME!!



- **Administrative Items & Announcements**
 - Safety
 - Agenda Changes
 - Forms in your booklet
 - Question Cards/Benchmarking Cards
 - SNUG Inc. Business Meeting
 - Board Meeting after today's session to elect officers for 2024-2025
 - Special Event Tonight
 - Buses for Rock & Roll Hall of Fame load at 5:30 PM



MORNING AGENDA

Agenda

- Welcome and Special Events: Curtiss-Wright
- Introductions
- Vendor Products and Services



Welcome to SNUG 2024!

***CURTISS -
WRIGHT***

Group Entertainment

■ Rock & Roll Hall of Fame

- Monday, July 15th
- Meet outside Cleveland Marriott East
- Buses leave at 5:30pm
- Dinner & explore museum from 6pm – 10pm

■ Curtiss-Wright Nuclear Parts Center Tour & Brewery Dinner

- Tuesday, July 16th
- Meet outside Cleveland Marriott East
- Bus leaves at 5pm
- Dinner & open bar at Fat Heads Beer Hall following the tour

INTRODUCTIONS

- Name
- Utility/Vendor
- Years with snubbers
- What do you want out of this conference?



Participating Vendors



ASC Engineered Solutions

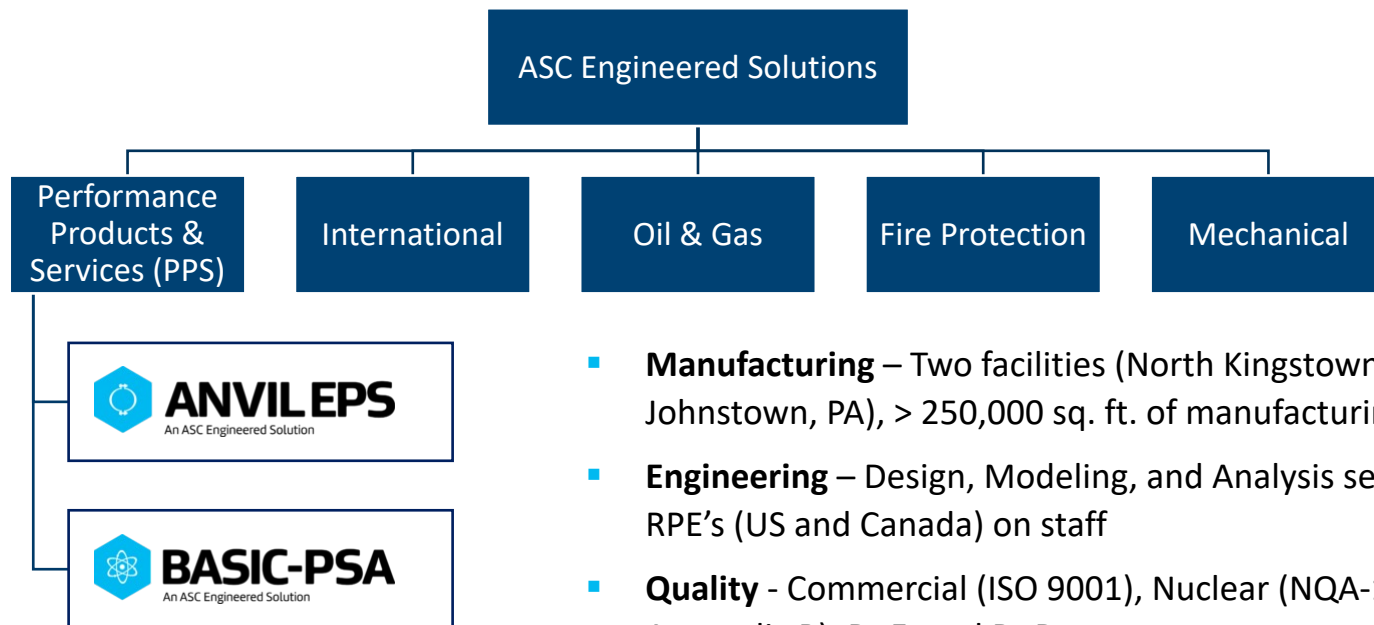
Overview – SNUG 2024



Building connections that last™



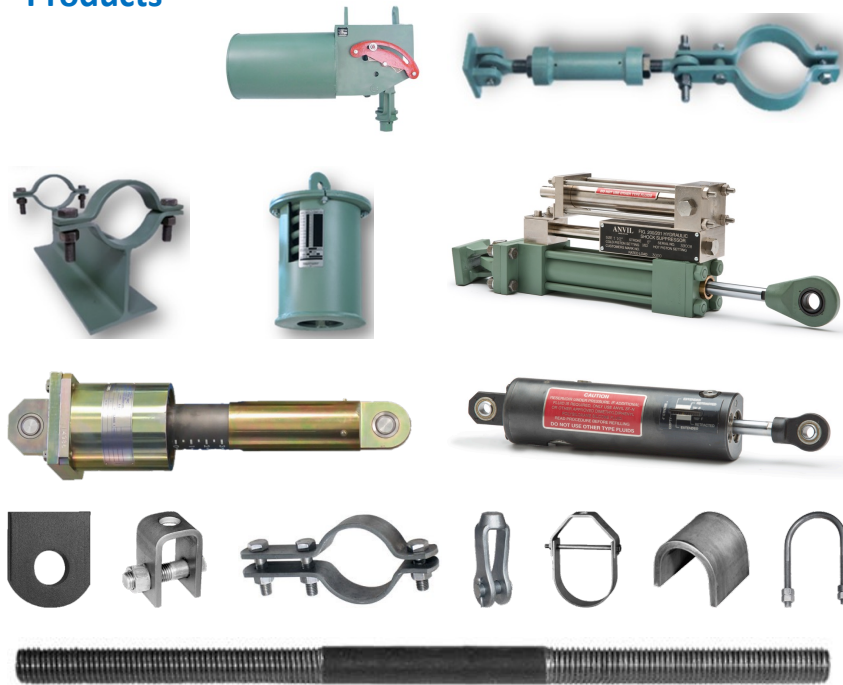
Company Structure



- **Manufacturing** – Two facilities (North Kingstown, RI & Johnstown, PA), > 250,000 sq. ft. of manufacturing space
- **Engineering** – Design, Modeling, and Analysis services with RPE's (US and Canada) on staff
- **Quality** - Commercial (ISO 9001), Nuclear (NQA-1 / Appendix B), DoE, and DoD programs

Product & Service Offerings

Products



Services (Field & Service Center)



Thank you

asc-es.com

Building connections that last



Barker/Diacon

Snubber Test Equipment

THE FORCE IN SNUBBER TESTING

1310 Miller Rd. Greenville, SC 29607

800-349-3149

jeff@barkerproducts.net nathaniel.potter@diaconcorp.com

www.barkerproducts.com www.diaconcorp.com

Snubber Test Bench Systems



Barker/Diacon

Snubber Test Bench Systems



Barker/Diacon

Snubber Test Bench Upgrade



Barker/Diacon

In-Place Test Machine

Model IPST-10

Quick Simple Setup & Operation

- Versatile, Continuous Duty Rated
- Activation Flow Rates to 18 GPM
- Max Pressure to 12,000 PSI
- Test snubbers, filter fluid or use as a flow bench to adjust control valves
- Operators can be up to 100 feet from snubber and instrument box
- Test snubbers as large as 20" bore and as small as 2 1/2" bore



Barker/Diacon

Portable Filter Machine

Model PFM-02

Stage 1

Dirt and Water Removal:

This Filter Stage removes both solid contaminants and water. 25 Micron Impregnated paper for dirt removal
Open Cell absorbent polymer water removal

Stage 2

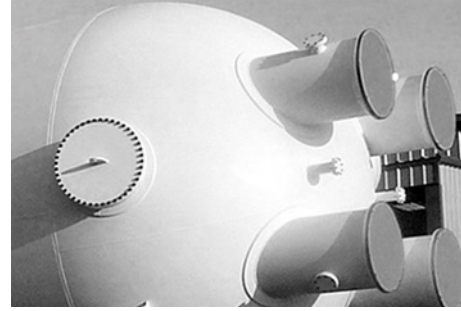
Polishing Element:

Filters suspended contaminants to 1 Micron in diameter Removal of oxidation and decomposition products from synthetic fluids



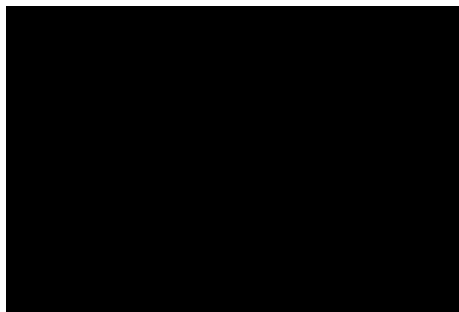
Fill the reservoir with fluid, set the timer and flow speed switches, and this machine will filter the fluid "Unattended" until the timer switch runs out. When either of the filter elements become dirty, the machine will automatically shut down. Warning lights on the panel will tell the operator that the filter elements need to be changed before the machine can be restarted. Fluid can be poured directly into the reservoir, or drawn from an external source by changing the external suction ball valve position

Barker/Diacon



Curtiss-Wright Nuclear Overview

John Knezevic, Director



Curtiss-Wright at a Glance

**CURTISS -
WRIGHT**

CW LISTED 1929



Formed in **1929** with the merger of the
Curtiss Aeroplane & Motor Company
and Wright Aeronautical Corporation

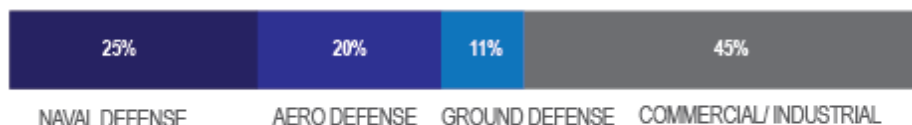


8600
EMPLOYEES

56% DEFENSE

45% COMMERCIAL & INDUSTRIAL

END MARKETS



8 OPERATING
DIVISIONS

Actuation
Industrial
Sensors
Surface Technologies
Defense Solutions
EMS
Nuclear
Valves

40 MAIN
LOCATIONS

90 COUNTRIES
SERVED

HQ: Davidson,
North Carolina



\$2.8

BILLION
IN 2023 SALES

\$9.0

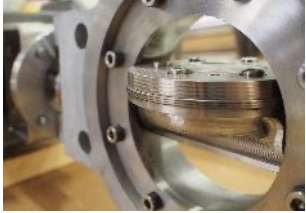
BILLION
MARKET CAP
2/14/24

ONE CW

VISION:

Enable our Customers' Success through
Market-leading Technologies

Broad Portfolio - Equipment



Flow Control Equipment

Severe service flow control equipment that supports the safe operation of nuclear plants including reactor coolant pumps, motors, and shaft seals; steam turbines; pressure relief, isolation, check, and control valves; hydraulic, electric, and pneumatic actuators; venturis; chillers, dampers, fans, and other HVAC equipment; hazardous waste pumps



Reactivity Control Equipment

Reactivity control equipment for Gen II, Gen III+, and advanced reactors including control rod drive mechanisms, control rods, and digital control systems; replacement neutron absorbers for spent fuel pools and dry casks; and in-situ neutron absorber testing (BADGER)



Electrical Equipment

Electrical interconnection products like electrical penetration assemblies, specialty cable assemblies, quick disconnects, conduit seals, Hi/Lo seals, and flex conduit. Electrical equipment including motor control centers, UPS systems, motors, switchgear, and relays



Containment Integrity Equipment

Containment integrity and safety equipment including personnel airlocks, equipment hatches, fuel transfer gates, and electrical penetration assemblies

Broad Portfolio - Services



Information Technology

Software and hardware that monitors and controls process plants including Plant Process Computer Systems, Thermal Performance Simulators, Wireless Monitoring Equipment, Condition Monitoring and Machine Learning Systems, Work Management Applications, Mobile Work Applications, and on-line Databases



Instrumentation & Control

I&C equipment ranging from complete control systems to individual modules, card repairs, and reverse-engineering solutions. System options include both analog (with isolated digital monitoring) and fully digital solutions. We have drop-in replacements for numerous legacy brands including GEMAC, Woodward, Rosemount, Foxboro, Versatile, Lisle-Metrix, Hagan, and Bailey



EQ, CGD and Parts

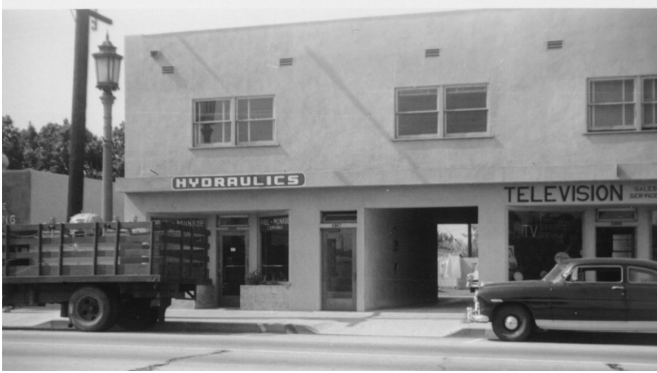
Tens of thousands of parts for mechanical, electrical, and I&C systems and equipment. We qualify equipment for safety related applications, conduct commercial grade dedication, reverse engineer replacements, and design custom equipment. We supply construction materials and offer solutions for obsolescence



Outage Equipment and Services

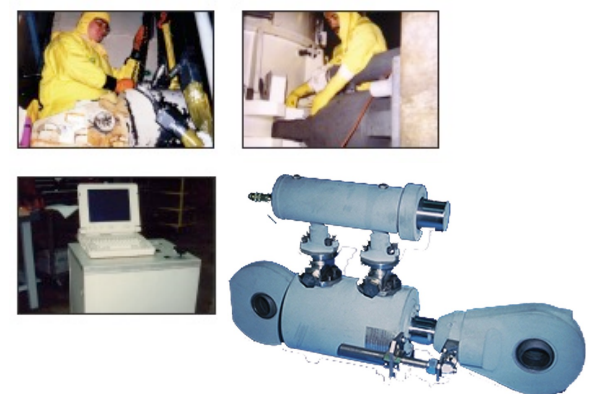
Equipment and inspection services to optimize outage performance including spent fuel management solutions, refueling outage tooling and services, tensioning systems, fluid leak detection and repair, advanced non-destructive examination solutions, eddy current testing, and heat exchanger inspection and repair products; pop-a-plugs

Enertech Early Beginnings



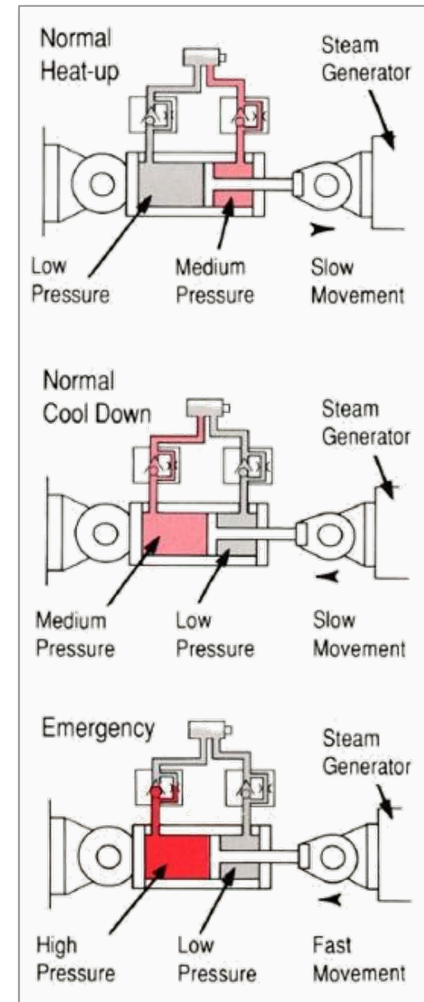
- Paul-Munroe Hydraulics Inc.
- California hydraulic distributor, manufacturer
- Enertech established 1987: P-M Energy Products

- Technology-defined company
- Hydraulic snubbers, EHOs
- Bettis distributor



Snubbers

- **Provide protection to major components during a seismic event**
 - Allows for thermal expansion and contraction during normal plant operation
- **Complete replacement, parts, and refurb support for:**
 - Enertech, Paul-Munroe, Anker-Holth/McDowell Wellman, E-Systems, Phoenix
- **Expanded onsite field service and outage support**
 - In cooperation with CW Sciencetech Outage and Field Management Solutions (OFMS) team



Large Bore Hydraulic Snubbers

Thank You

***CURTISS -
WRIGHT***

Questions?

www.cwnuclear.com



element
NUCLEAR





GERB

Vibration Control Systems



SOCOTEC



Business Profile, Capabilities & Products



Summer Conference & Trade Show
July 15, 16, 17, & 18, 2024



Business Profile

Location

- Headquarters in Columbia, NJ
- Full Design, Manufacturing & Testing Facility
- Remote Representatives across North America



Capability

- Remote Visual Inspection (RVI) Products
- Foreign Object Search and Retrieval (FOSAR) Tools
- Custom Engineering Capabilities

Industries

- Aerospace/Aviation
- Structural Inspection/Surveillance
- General Manufacturing
- Government/Defense
- Nuclear Power Generation





Nuclear Power Generation RVI/FOSAR Products

Retrieval Tools

Up to 50 lbs gripping force at 30° closure

Motorized and Manual Tools

Articulating Guide Tubes

Video Borescopes

Inspect inaccessible areas safely & quickly

Articulating, Full-HD Portable/Benchtop Video Borescopes

XtendaCam HD Air

Extends up to 25 ft

NEW PRODUCT

< 10 lbs total weight

Tablet-based, Lightweight Pole Camera

PTZ Cameras

Various Sizes
28 - 90 mm OD

NEW PRODUCT

Use with Singular Controller/Recorder

Modular PTZ and PT Camera Heads



Xtend-a cam™ HD AIR

Features

- Camera Heads: Swappable 10x or 30x Optical Zoom
- Weight: < 10 lbs
- Pole Length: 25'
- Pole Material: Carbon Fiber w/ anti-spin notching
- Wireless Camera Interface: creates own WiFi access point
- User Interface/Display: iOS / Android Tablet/Phone
- Image/Video Capture: Touch Screen GUI
- Storage Media: Internal SSD
- IP Rating: IP50
- Battery: Commercially available, rechargeable 12V
- Battery Life: 2 hours
- Lighting: Integrated White LED
- Tilt Control: Joystick Digital Proportional Control
- Stabilization: Foot Gimble for Single Operator Control





XtendaCamTM HD AIR

Manual Inspection



Scaffolding Build/Setup
4 people, 1 shift, \$2000 cost (on avg)



Long Inspection Times



Risk of Workplace Incident
Personnel 30' feet above work areas

XtendaCam HD AIR Inspection



No scaffolding setup



Single inspector operation



10-minute inspections



Safer Workplace



VT-3 Qualified*

*InterTest customers able to get
XtendaCam qualified for VT-3 inspection work.



XtendaTM cam HD AIR



LAKE ENGINEERING COMPANY

ESTABLISHED 1984

TECHNICAL SERVICES

**SNUBBER AND PIPE SUPPORT DESIGN
SERVICES**

SEAL LIFE EVALUATION

FLUID ANALYSIS

SNUBBER AND PIPE SUPPORT TRAINING

REVERSE ENGINEERING

MATERIALS

SNUBBERS AND PIPE SUPPORTS

REPLACEMENT PARTS

SEAL KITS

SILICONE FLUIDS

MECHANICAL SNUBBER TOOLS



LISEGA

Company Overview

Dave Dutrow
Nuclear Sales Manager

Located in Kodak, TN



LISEGA Facilities



*Zeven, Germany –
Main plant*

Zeven, Germany

Kodak, TN



Kodak, USA



Bondoufle, France

Bondoufle, France

Shanghai, China



Shanghai, China



Al-Jubail, Saudi Arabia

New Delhi, India

Netherton, England



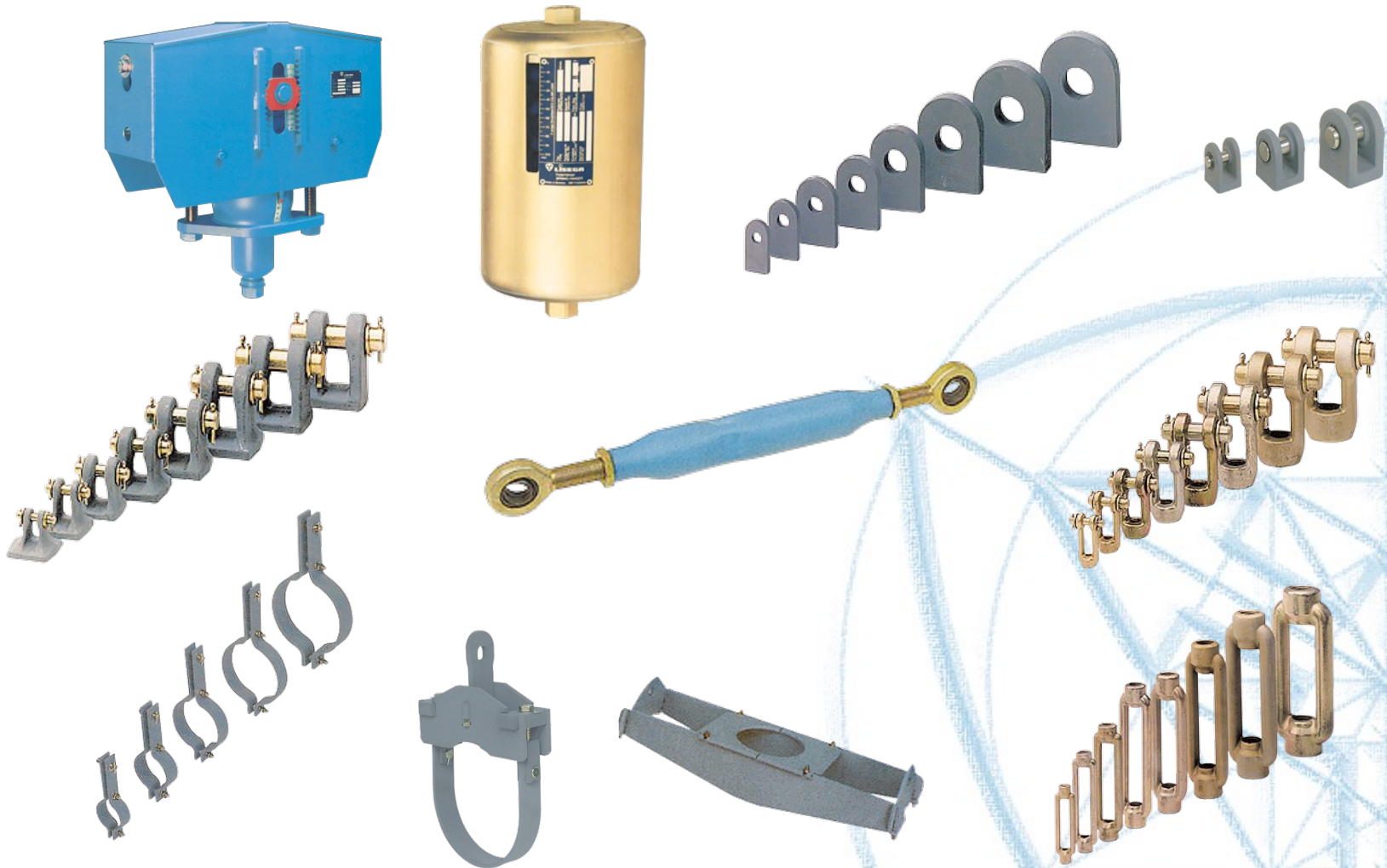
Netherton, England

*Wittenburg, Germany
(LISEGA affiliate for
connections)*

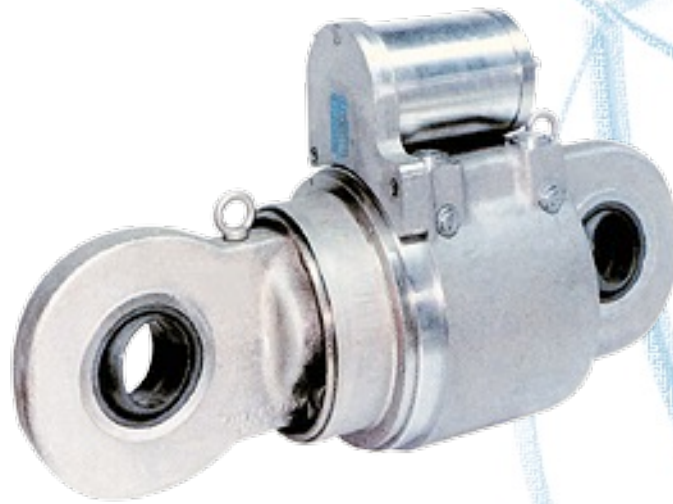


Wittenburg, Germany

LISEGA Parts



Piping & Large Bore Snubbers

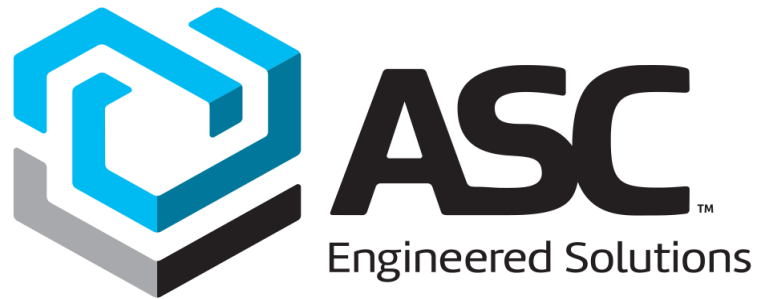


Questions?



50 Years
Performance with System

Lunch



Building connections that last™

RETURN BY 1:00 PM

ADMINISTRATIVE ITEMS

ED DUNDON

○ General Items

- Question Cards / Benchmarking Cards

○ Agenda Overview

- Millstone Steam Generator Snubber Issue
- Element – This is What We Do
- Seal life Evaluations
- SF-1143 / SF-N Fluid
- Unusual Snubber Fluid Issue SF-1154
- Question Cards
- SNUG Inc. Business Meeting
- Load buses for trip to Rock & Roll Hall of Fame
- !! Eat and have fun !!



SNUG 2024 Presentation
Millstone Unit 3
Steam Generator Snubber Issue
from 3R22

Ed Dundon

Millstone Unit 3

- Large Bore Snubber DTPG
 - 44 Snubbers to restrain 4 Steam Generators & 4 RC pumps
 - Paul Munroe 2000 kips hydraulic snubbers
 - Weight 2000 lbs
 - Pinned at each end
 - 8 snubbers per Steam Generator
 - 3 snubbers per RC pump

MP3 SG DTPG

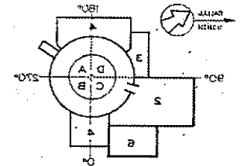
- Large Bore Snubber
 - 5 SG/RCP large bore snubbers are selected each outage
 - Tension and compression fluid samples
 - Separate control valve testing
 - Low pressure testing of the piston seal
 - Visual examination of the externals with cold piston setting verified

MP3 SG DTPG cont.

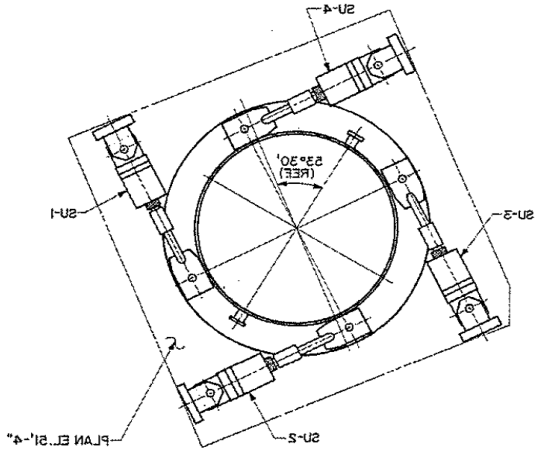
- Initial Scope (5 snubbers)
 - SG-A 2 upper snubbers
 - SG-A 1 lower snubber
 - SG-B 1 lower snubber
 - SG-D 1 upper snubber
- As Found “C” dimension cold (CPS) with upper limit of 7 -11/16”

NOTE:
VENDORS
DRAWINGS
REF
15178-CN-RC2-2914

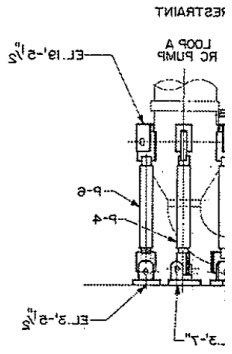
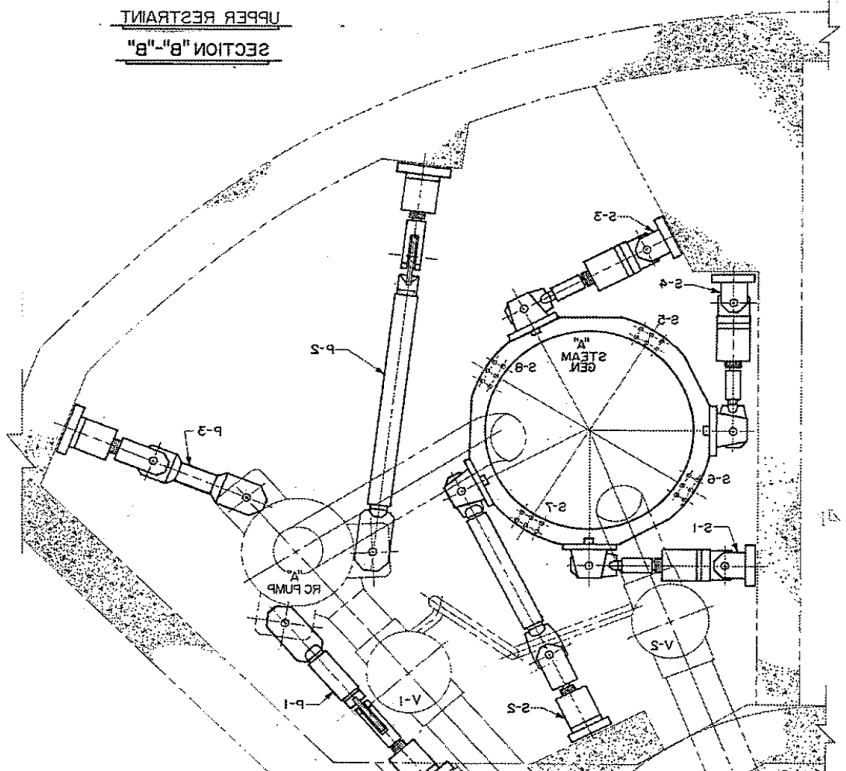
2 FUEL BUILDING
3 REACTOR CONTAINMENT
4 REACTOR BUILDING
5 MAIN STEAM VALVE BLDG
6 CONTROL & SERVICE BLDG



STEAM GENERATOR
DIAGRAM



SECTION "B-B"
UPPER RESTRAINT

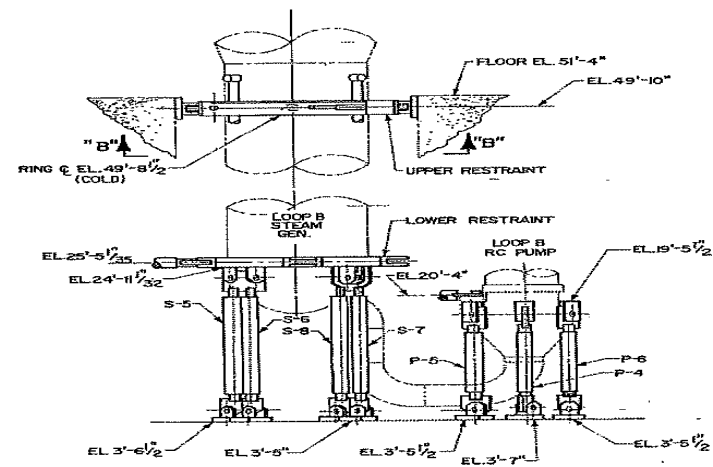


RESTRAINT

RESTRAINT

"B"

FLOOR EL-21-4"
EL-48-10"



SECTION "A"-"A"

Millstone Unit 3

- Ring Design

- Upper Ring

- Dead weight supported from two trunnions on SG. U bar with bolts holds up the ring & snubbers
 - 4 Snubbers to restrain lateral movements of the SG
 - Gap between ring & SG vessel to allow SG to grow radially outward

- Lower Ring

- Dead weight supported from four struts from under the ring.
 - 4 Snubbers to restrain lateral movement of the SG
 - Gap between ring & SG vessel to allow SG to grow radially outward



MP3 SG As Found Visual Examination results

- Initial Scope (5 snubbers)
 - SG-A 2 upper snubbers (snubber #'s 47 & 48)
 - SG-A 1 lower snubber (snubber # 04)
 - SG-B 1 lower snubber (snubber # 02)
 - SG-D 1 upper snubber (snubber # 29)
- As Found C dimension cold with upper limit of 7 -11/16"
 - SG-A 2 upper snubbers #'s 47 @ **7 -13/16"** & 48 @ 6- 15/16"
 - SG-A 1 lower snubber #4 @ 4 - ½"
 - SG-B 1 lower snubber #2 @ 6 -7/8"
 - SG-D 1 upper snubber #29 @ 5-7/16"

Immediate Actions

- Issued condition report documenting as found cold piston setting exceeded the S&W piping spec.
- Reviewed 100% visual examination report from 2019
 - Found high but within tolerance.
- Contacted vendor to determine if the SG snubber has additional travel margin.
 - Need to determine if snubber bottomed out & was damaged
- Issued work orders for scope expansion of 3 more SG snubbers (5% increase) for visual expanded.
 - Three additional snubber were from the same SG
 - 2 more snubbers from upper ring & 1 more from lower SG ring
- Pulled drawings to understand how the SG snubbers were supported & attached to the SG

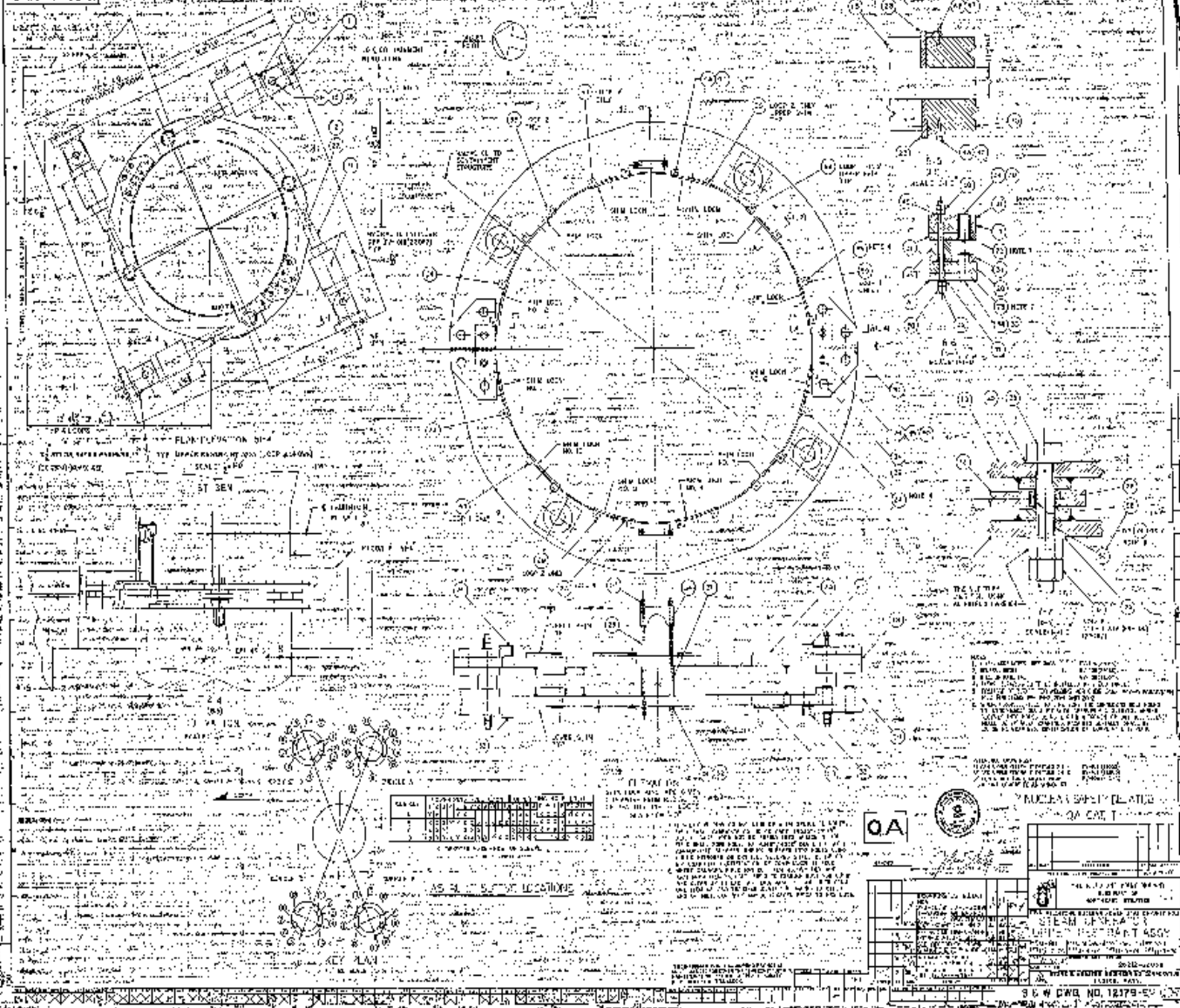
Additional Actions

- Completed visual examination of 3 more SG snubbers
 - All four upper snubbers on the upper A SG ring were now examined.
 - 2 of 4 lower SG ring snubbers were examined
- Worked with Vendor & determined that no SG snubber had bottomed out. S&W spec for snubber travel was conservative.
 - Eliminated the need to functionally test & inspect Snubber # 47.
 - Eliminated the need to determine additional loading & stress on the SG from thermal growth
- Removed SG insulation around the SG ring, the SG snubbers & the SG vessel to assess condition

MP3 SG Expanded As Found Visual Examination results

- As Found C dimension cold with upper limit of $7 - 11/16''$
 - SG-A 2 upper snubbers #'s 31 @ $4 - 5/16''$ & 36 @ $7 - 1/16''$
 - SG A 1 lower snubber #1 @ $3 - 1/4''$
- Only upper ring has one snubber that exceeded CPS criteria & one snubber with CPS above $7''$

100-45-52-21



Restoring ring and snubbers back to original position

- Worked with snubber vendor on a plan to rotate ring with installed SG snubbers.
- Used SG snubber main piston seal test report to verify all seals could be pressurized to create a hydraulic ram
- 4 hand pumps were cleaned & purged using SF-1154. SG-1154 was the working fluid for hand pumps & SG snubbers
- Remove any debris between SG vessel, shim plates and ring. Restored gap between shim plates & vessel
- Installed hand pumps (hydraulic ram) on compression side of piston to compress snubbers to historical CPS locations.
- Used scuffing marks on SG for independent method of confirming location

Restoring ring & snubbers back to original position (cont.)

- Used scuffing marks on SG for independent method of confirming location
- Pressurized all four snubbers simultaneously.
- Initial pressure was 30 psig with maximum pressure limit of 100 psig. Pressure based on main seal test report.
- Stopping at 5 psia increment and confirming reading of CPS, shim plate tolerance and fluid levels in hand pump reservoir. (Prevent air intrusion into the main cylinder of snubber)
- Waited 10 minutes to settle travel out.
- Then repeated steps until desired travel was reached.

3R23

- Examined 4 upper SG snubbers & ring on “A” SG
- Select visual examination on another SG support ring.



Element Materials Technology Element Nuclear Presentation to 2024 SNUG Conference

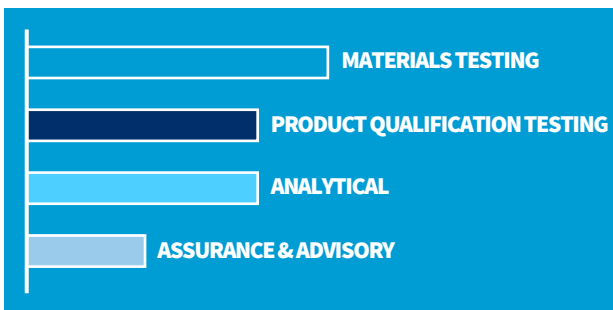


The recognized leader in Testing,
Inspection and Certification Services
to a diverse range of industry sectors
where failure in service is not an
option

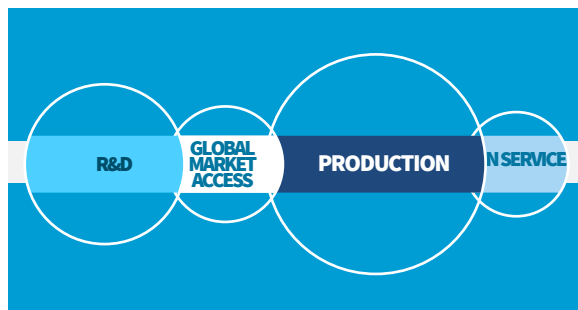
THIS IS WHAT WE DO



SERVICE MIX



PRODUCT CYCLE

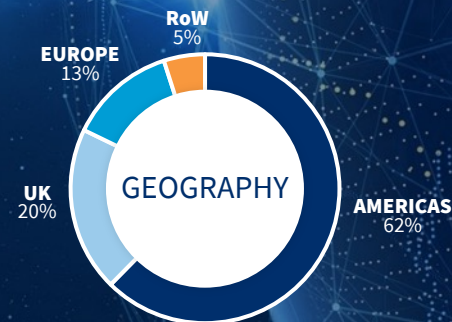
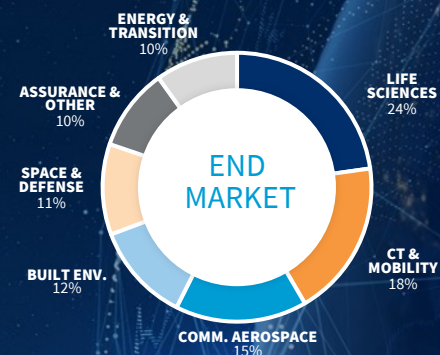


REGULATORY



REGULATORY
NON-REGULATORY

Revenue underpinned by regulatory & industry supply chain requirements



SO FAR



TESTING, INSPECTION
AND CERTIFICATION FOR

55,000+

CUSTOMERS

CONNECTED TECHNOLOGIES

MOBILITY

LIFE SCIENCES

BUILT ENVIRONMENT

AEROSPACE

OUR PURPOSE

**MAKING
TOMORROW
SAFER
THAN TODAY**



60%+

REVENUE HELPING
CUSTOMER
SUSTAINABILITY
JOURNEYS

#1

ESG RANKING IN
INDUSTRY VIA
SUSTAINALYTICS

10x

REVENUE
GROWTH TO OVER
\$1.5B

47

ACQUISITIONS

OUR PURPOSE & VALUES



Making tomorrow safer than today



INTEGRITY



CARE



PROGRESS

OUR ESG COMMITMENTS

ELEMENT POSITIVE + IMPACT

Making tomorrow safer than today

**NET-ZERO
EMISSIONS**
BY 2035

30%
WOMEN IN
LEADERSHIP

25%
ETHNIC MINORITY
REPRESENTATION

25,000
VOLUNTEERING
HOURS

#1
SUSTAINALYTICS

INDUSTRIES SERVED



AVIATION

- FAA and Private Aircraft Industry Development and Evaluation Programs
- Insight to Regulatory, Safety, and Service Considerations Early in the Design Process
- **Up Front Review Services** to Identify Potential Problems and Reduce Delays in the Product Development and Release Process



DEFENSE

- **Complete EMI/EMC Test Capabilities**
- Comprehensive Suite of Ballistic and Warhead Live Fire Testing and Characterization
- All Military Standard Qualification Environmental, Dynamics, and Mechanical Testing



SPACE

- Astronautics and Propulsion Testing
- **Rocket Thrust Stand and Exhaust Duct Testing**
- Space Simulation/Thermal Vacuum Cycling
- Extreme Environmental Testing, Including Pyroshock, High Intensity Vibration, and Launch Level Acoustics

INDUSTRIES SERVED



ENERGY

- Materials characterization and testing, failure analysis, weld qualification and engineering critical assessments for offshore, onshore and distribution
- The industry's most comprehensive nuclear testing and qualification service portfolio
- Hydrogen, wind and solar
- Unparalleled predictive capabilities with digital modeling



INDUSTRIALS

- Destructive and non-destructive testing, failure analysis, material characterization, product testing and certification for:
 - Metals and polymers
 - Consumer products
 - Furniture and mattresses
 - Building products & infrastructure
 - Plastics and textiles
 - Concrete
 - Geotechnical
 - Food and medical equipment
 - Expert witness services

HOW WE PROVIDE VALUE TO YOU

UNPARALLELED DELIVERY TIME FOR PROJECTS OF ANY SIZE,
DURATION OR LOCATION

PEACE OF MIND WITH ROBUST PROGRAM MANAGEMENT & SEAMLESS
COMMUNICATION

TEST RESULTS WITH UNMATCHED LEVELS OF ACCURACY, QUALITY
AND CLARITY

UNMATCHED CAPABILITIES & CAPACITY, DE-RISKING YOUR
DEVELOPMENT CYCLE & OFFERING EXTENSIVE GEOGRAPHIC REACH
DIRECT ACCESS TO TOP ENGINEERING EXPERTS FOR TECHNICAL
GUIDANCE



UNRIVALED CAPACITY & CAPABILITY

800+

stress &
creep
frames

200+

environmental
chambers



120

dynamics
systems

The
largest
network of
EMI chambers in
North America

ACCREDITED AND APPROVED

- Aerojet Rocketdyne
- Airbus
- Aircelle
- Beechcraft
- Bell
- Boehler
- Boeing
- Bombardier
- Cessna
- DNV GL
- Eaton
- GE Aviation
- GE Energy & Power
- GE Oil & Gas
- GKN
- Goodrich
- Gulfstream
- Hamilton Sundstrand
- Honda Aerospace
- Honeywell
- IHI
- ITP
- KHI
- Lockheed Martin (Aerospace)
- Lockheed Martin
- Lockheed Martin (Space)
- Messier Dowty
- Moog
- Northrop Grumman
- Parker
- Pratt & Whitney
- Pratt & Whitney Canada
- Raytheon
- Robinson Helicopter
- Rolls-Royce (Deutschland)
- Rolls-Royce (UK)
- SAFRAN
- Schweizer
- Siemens
- Sikorsky
- SNECMA
- SpaceX
- Turbomeca
- United Launch Alliance
- UTC
- Volvo



COMPLIANCE AND CERTIFICATIONS

COMPLIANCE

ITAR
NIST 800-171

CERTIFICATIONS

ADS-37A-PRF	MIL-STD-767
DEF STAN 00-35	MIL-STD-810
DEF STAN -59-411	MIL-STD-883
DEF STAN 61-5	MIL-STD-1130
MIL-DTL-901E	MIL-STD-1275
MIL-STD-120	MIL-STD-2105
MIL-STD-167	MIL-I-46058C
MIL-STD-202	MIL-PRF-28800
MIL-STD-248	MIL-PRF-31032
MIL-STD 461	MIL-PRF-50884D
MIL-STD 462	MIL-PRF-55110
MIL-STD-464	and more
MIL-STD-516	
MIL-STD-704	

NTS IS NOW PART OF ELEMENT



- Together, we now offer our customers **greater capacity, new capabilities and greater technical strength.**
- #1 globally in product qualification testing for complex, highly regulated end markets
- #1 globally in space and defense testing
- #1 globally in aerospace materials testing
- #3 globally in connected technologies testing
- Expanded capabilities in telecommunications, automotive, medical device and battery testing
- What is the customer impact?
 - Same high level of quality and service
 - New services and options available
 - Increased capacity for easier scheduling
 - Ability to consolidate supply chains, reducing the need for third parties
 - No impact on approvals and accreditations
 - Long-term agreements, NDAs, MSAs and other contractual agreements remain in place
 - Critical and sensitive data will remain completely secure

Element's Testing Capabilities

Mechanical Testing • Static & Fatigue • Abrasion & Wear Testing • Hardness • Fracture Mechanics • General Mechanical Properties • Weld Testing	Metallography • Preparation • Macroscopic Evaluation • Microscopic Evaluation • Grain Size • Surface Discontinuities • IGA/IGC • SEM/EDS	Chemical Analysis • Metal Composition • Polymer Composition • OES • ICP • AAS • FTIR • Positive Material Identification	Polymer/Composite • Polymers • Plastic Pipes • Composites • Thermal Analysis • Ash Content • Gel Time • Viscosity	Corrosion • Salt Spray/Cyclic • CASS • Hydrogen Cracking • Sulfide Cracking • Autoclave • Pitting & Crevice Corrosion	NDT • Liquid Penetrant • Magnetic Particle • Radiographic • Ultrasonic • Visual Inspection	Misc. Material Tests • Additive Manufacturing • Flammability • Permeability • Conductivity • Thermal Expansion • Residual Stress
Environmental Simulation • MIL-STD-810 • RTCA DO-160 • Altitude/Vibration • Fire Resistance • HALT/HASS • Corrosion Testing • Temp/Humidity • Ingress Protection • Ozone • Package Testing	EMC/EMI • Radiated Emissions • Conducted Emissions • Radiated Immunity • Conducted Immunity • ESD • OTA • SAR	Products, Systems, Structures • Aerospace • Transport • Oil & Gas • Calibration • Consumer Products • Fluids & Lubricants • Medical Devices • Building & Infrastructure • Numerical Modeling	Environmental Sciences • Drinking Water & Wastewater • Soil & Solid Waste • Air Quality & Stack Emissions • Occupational Hygiene • Hydrocarbons • Heavy Metals Analysis • On-Site Services	Food/Pharmaceutical Chemistry • Food Nutrition, Allergens, Toxins, and Additives • Pharmaceutical Composition, Potency, E&L, Stability, Sterility & Pathogens • Microbiological Pathogens & Organisms	Certification & Advisory • Failure Analysis • Expert Witness • Litigation • On-Site Services • Wireless/Zigbee • ATEX Certification • CB Scheme (IECEE)	Fire Testing and Services • Reaction to Fire • Fire Resistance • Training • Inspection/Certification • Desktop studies • Timber • Structural • FIRAS/FRACS

Element's Global Capability Overview

Element Nuclear

OUR KEY SERVICES INCLUDE:

QUALIFICATION TEST SERVICES

- Four Seismic Simulators
- Six Accident Test Autoclaves
- One 150 psi, 3,000 lbs. per hour boiler
- 300KW Steam Super Heater System
- One Boron Chemical Spray Injection System
- Seven EMI Test Rooms

THIRD-PARTY QUALIFICATION

- Sole Supplier of Yokogawa Products
- 4000+ previously qualified items
- Cybersecurity Services
- Material Verification

VALVE TESTING SERVICES

- Three Safety Relief Valve Test Cells for steam, water and air
- UPGRADED Full Flow Steam Test System to 2,000,000 lbs/hr max. and 1400 psi max.
- Full Flow Hot Water Test System 2200 psi
- Hot Water Closed Loop Flow System 30,000 gallons

- Cold Water Closed Flow Loop System 60,000 gallons
- Two 3,000 psi, 6,000 lbs. per hour boilers & One 1,500 psi 12,000 lbs. per hour boiler

DETAILED SERVICES

- Safety Relief Valve Testing and Certification Services (ASME OM Code, Set Pressure, Seat Leakage and Operability with Steam/Water/Air, and Repair Support)
- Valve and other Fluid Component Testing Services (ASME QME-1, Hot and Cold Cycle Testing, Flow Interruption, Deflection and Modal Testing, Steam/Water/Air)
- Snubber Inspection, Testing and Refurbishment Services (ASME OM Code, Removal, Installation, Inspection, Repair, Refurbishment)
- Equipment Qualification Engineering and Testing Services (Radiation Aging, Thermal Aging, Cycle Aging, EMI, Seismic, and Accident (LOCA) Simulation)
- Safety Related Equipment Supply and Third Party Qualification (NTS is the Exclusive Provider of Yokogawa Instruments and Replacement Parts)

Huntsville Site Specifications

RADIOACTIVE MATERIAL LICENSED

Element Nuclear holds a Radioactive Material License from the State of Alabama and is audited by the US Nuclear Regulatory Commission (USNRC), Nuclear Procurement Issues Committee (NUPIC), and Nuclear Industry Assessment Committee (NIAC) along with ISO 9001 and A2LA certification and accreditation. The lab offers full-service engineering and testing organization to support electrical and mechanical equipment qualification to the requirements of 10CFR50.49, IEEE Standards 323 and 344 and ASME QME-1.

ICAP CERTIFIED

Element Nuclear has earned IEEE's Conformity Assessment Program (ICAP) Certification. The ICAP certification permits Element to connect directly to manufacturers through a standard of product qualification testing and standardized reporting resulting in streamlined approval processes for customers worldwide.

ICAP certification is important for expediting market adoption while reducing implementation costs. The program is specifically designed to ensure product conformity to IEEE standards, thus reducing testing burdens on manufacturers that need to meet multiple programs for different end-users or buyers. ICAP also enables trade across state and international boundaries with the assurance of operating safely and reliably within certain measurable performance criteria.

HUNTSVILLE CAMPUS

The Element Huntsville campus is a massive 238,196 square foot laboratory, which specializes in large-scale and custom testing for the defense, nuclear, commercial, telecommunications, transportation, space, and aerospace sectors. Our 115.6 acre facility has qualified more equipment than any other company in the industry and is home to:

- Element Materials Technology Huntsville Nuclear - a Center of Excellence
- 50+ Environmental Simulation Chambers/Systems
- EMI/EMC Testing to EPRI, Nuclear Regulatory, FCC, and DoD Standards
- 50+ Environmental Simulation Chambers/Systems
- Advanced Dynamics & Structural Load Testing
- High-Flow Steam & Water Capabilities
- Acoustic Noise Chamber Testing, Design, Refurbishment
- Advanced Calibration Services

Element Huntsville



High Flow Steam Test



End Loading & Modal Testing



Safety Relief Valve Flow Test



Water Flow Loop Simulation



SRV Testing



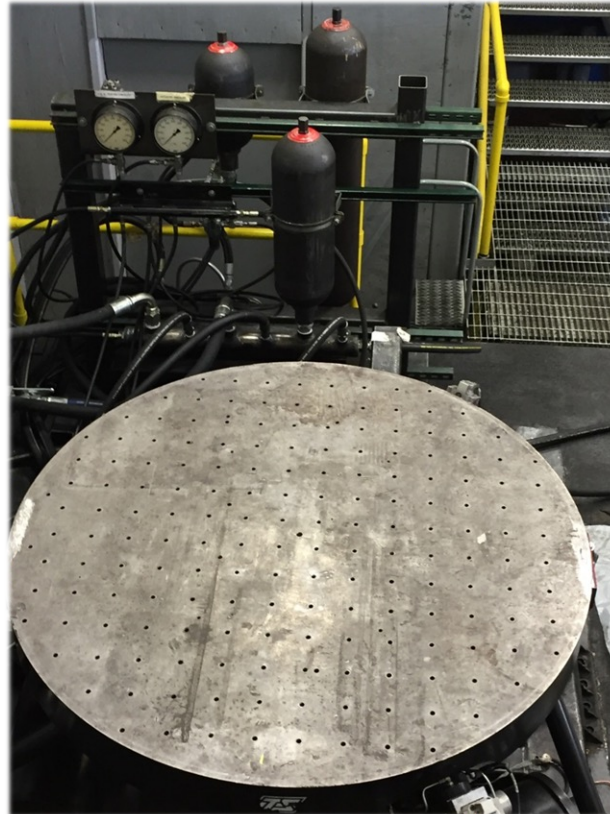
Tri-Axial Seismic Table



Bi-Axial Seismic Table



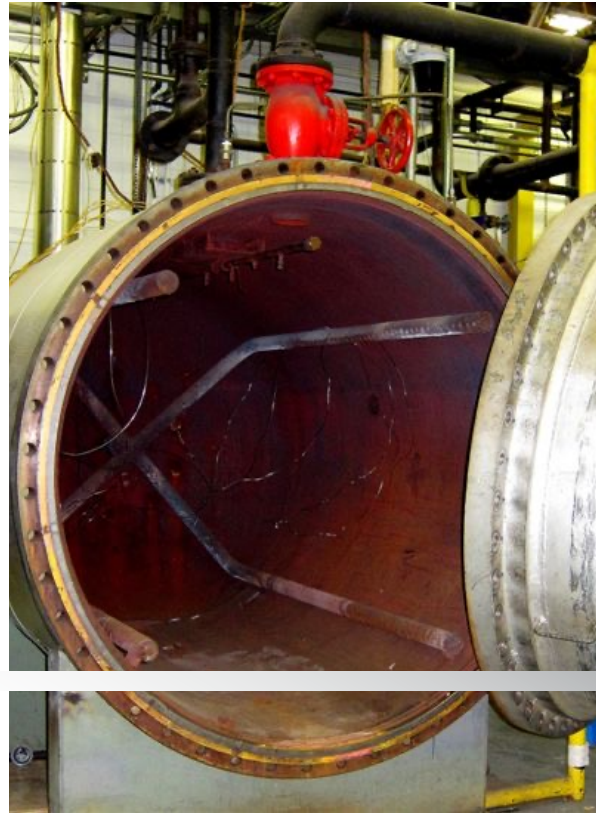
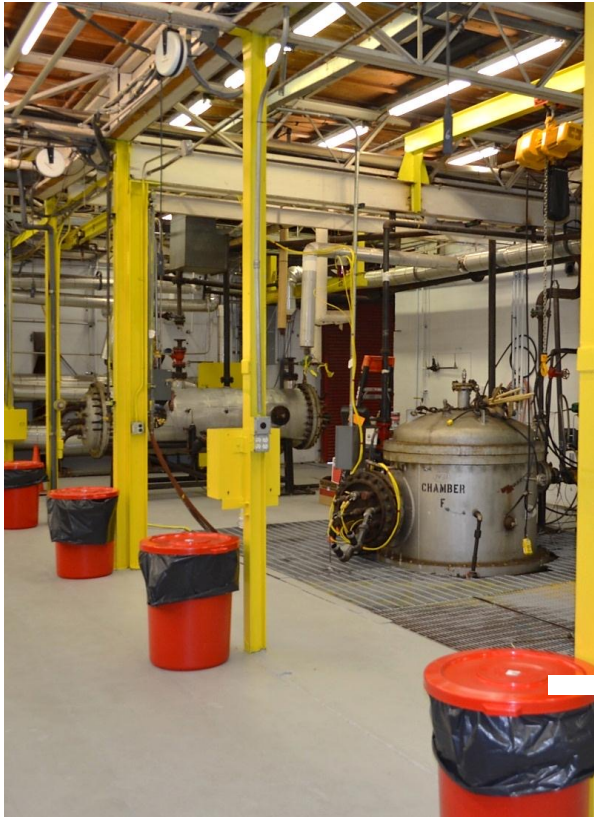
Tri-Axial Seismic Table



Single Axis Seismic Table



LOCA Chambers



Single Axis Seismic Table



Thermal Aging Chamber



EMI EMC Testing

- 7 EMI Chambers
- Emissions Testing to 44 GHz
- Susceptibility Testing to 40 GHz @ 200 volts/meter
- Screen Room for large items/vehicles
 - Overall Dimensions - L x W x H (feet)
55 x 35 x 17
- MIL-STD-461, MIL-STD-464 EMI Testing
- Power Quality Testing
- Nuclear Power Industry EMI Testing per EPRI TR-102323 and NRG 1.180
- Multiple Power Sources at Various Voltages and Frequencies
- Special R&D Daily Rates



Third Party Qualification



Bussmann Fuses



GEMS Sensor



**Yokogawa DX2000
DXAdvanced Series Recorders**



NTS 812 Relay

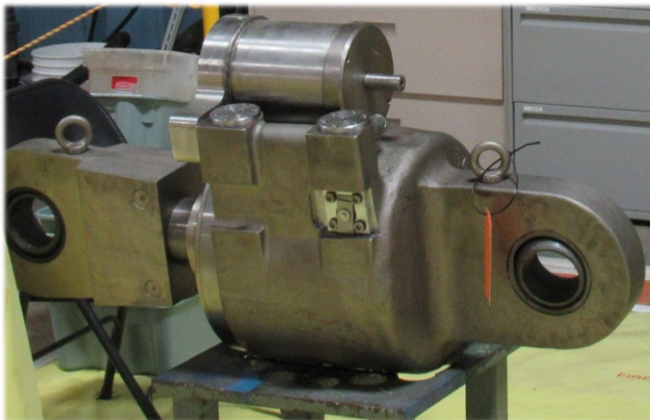
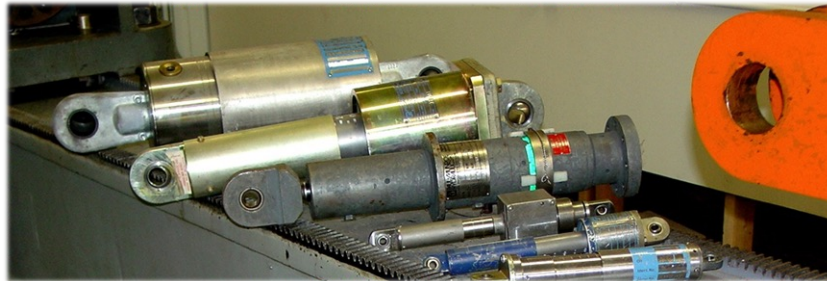
Third Party Qualification Lab



TPQ Inventory



Snubber Test Services



Snubber Test Trailer



Snubber Test Lab



Advanced Reactor Test Facility

- Two boilers rated at 3100 psig at saturated conditions with a total flow of 13,800 lbm/hr.
- Two steam accumulators with 908 cu ft. of steam accumulation, rated 2660 psig at 700°F, are connected for use when fast ramp conditions are required.
- An electric boiler for long term testing that requires saturated steam.
- New superheater rated 3100 psig at 1000°F and 3 million BTU/hour output.
- Nominal superheated steam temperature is expected to be 865°F but is adjustable from 650°F to 1000°F.
- Superheater will be able to flow 12,000 lbm/hr at 1,200 psig and 865°F during maximum flow operation. The superheater temperature and pressure are adjustable.
- Four new test chambers are part of the LOCA system.
- Horizontal and Vertical 47.5" ID by 60" straight side length chambers design rated 1500 psig/700°F.
- Two horizontal HELB chambers are 84" ID by 70" straight side length are design rated 50 psig/625°F.
- All four chambers have full body flanges and various nozzle penetrations.
- The chambers have steam coils affixed outside of the chambers, so the chamber wall temperature is heated to desired temperature to minimize condensing steam and keep the chamber wall from drawing heat from incoming steam. This will make for a smoother and more rapid ramp.
- A vacuum system is part of the design and allows various levels of vacuum to be pulled on the chambers.
- System is designed to meet very fast ramp requirements required by customers.

Advanced Reactor Test Facility

Project Timeline

- Q4 2023- SMR Building complete, Equipment arriving on site, all CAPX issued to vendors
- Q1 2024- Construction complete by end of Q1
- Q2 2024- Testing and commissioning of system
- Q3 2024 - facility open for testing



- The new test building is 30' x 90' open bay for the test chambers and has workspace for specimen preparation. A separate, standalone control room is located next to test building.

**THANK
YOU**

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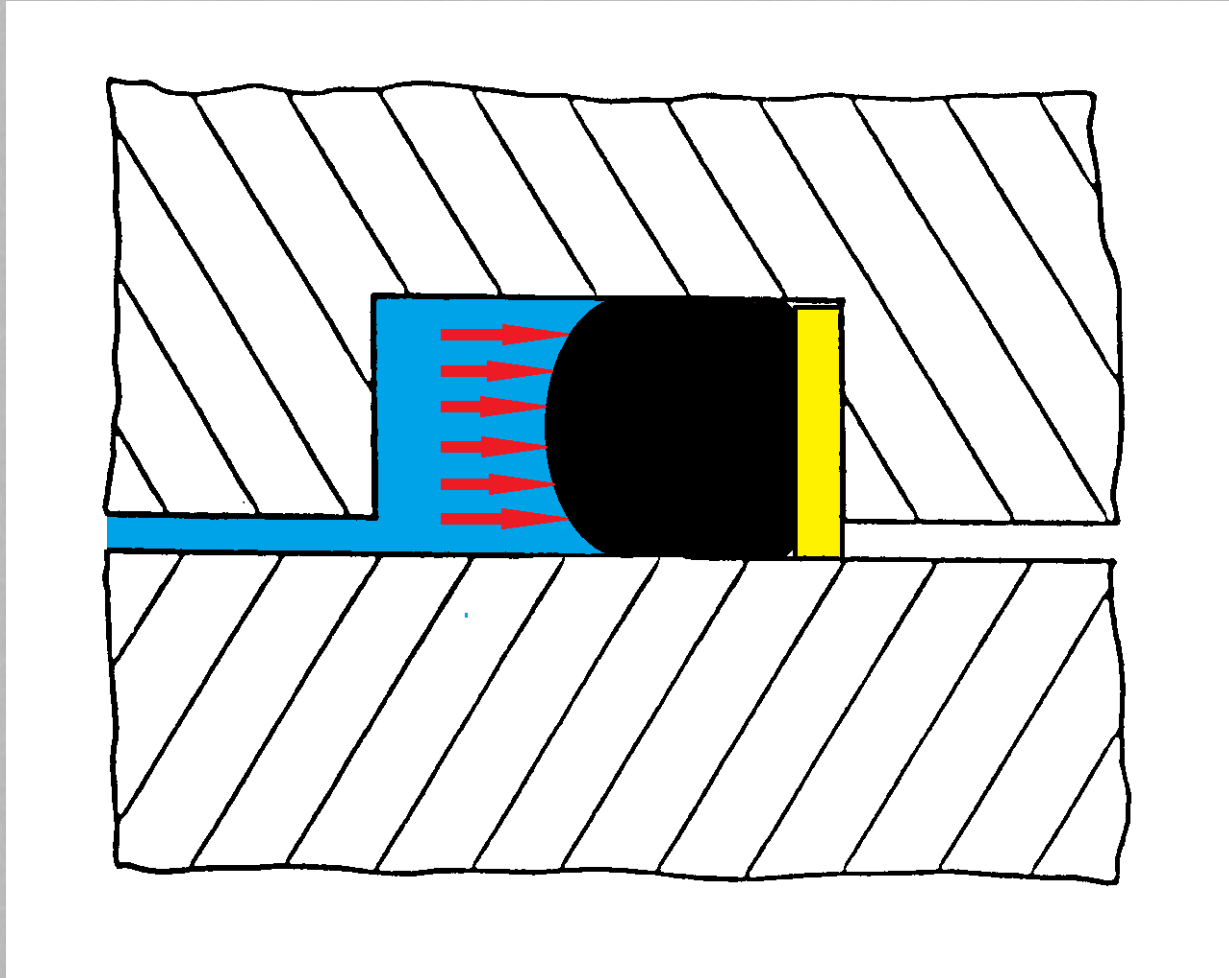
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***EVALUATION OF THE
SERVICE LIFE OF
SEALS IN LISEGA
SNUBBERS AT
HOPE CREEK STATION***

SNUBBER SEALS HAVE TWO PRIMARY FUNCTIONS

- A) MAINTAIN A HIGH PRESSURE FLUID BOUNDARY
WHEN THE SNUBBER IS ACTIVATED**
- B) MAINTAIN A LOW PRESSURE FLUID
CONTAINMENT BOUNDARY WHEN THE SNUBBER
NOT ACTIVATED**

O-RING SEAL AT HIGH PRESSURE

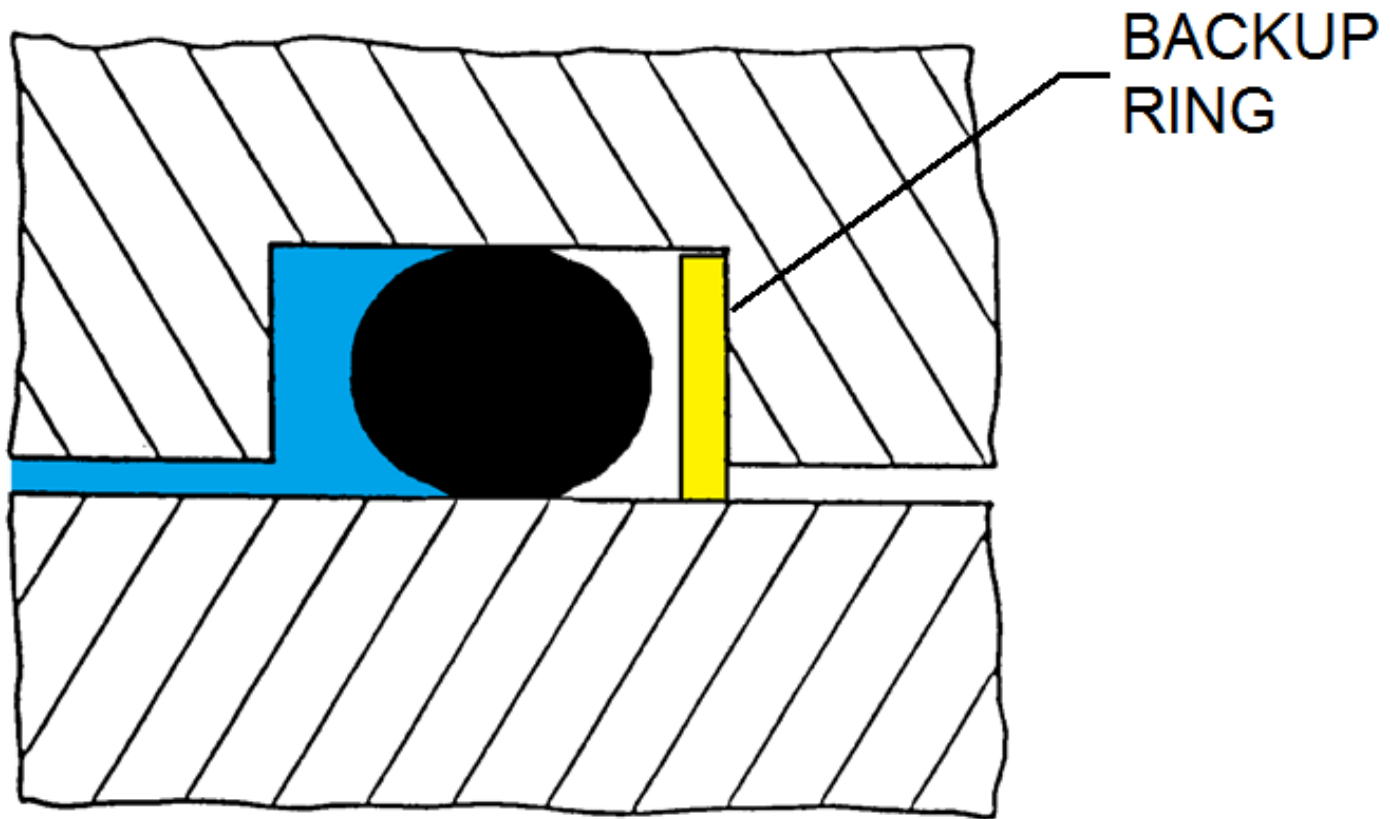


HIGH PRESSURE SEAL FAILURE

**FAILURE OF AN ELASTOMERIC SNUBBER SEAL TO
MAINTAIN THE HIGH PRESSURE FLUID
BOUNDARY IS UNCOMMON**

**ON THE RARE OCCASIONS THAT SUCH FAILURES
HAVE OCCURRED THE CAUSE OF THE FAILURE
HAS TYPICALLY BEEN DESIGN OR ASSEMBLY
INADEQUACIES**

O-RING SEAL AT LOW PRESSURE



LOW PRESSURE SEAL FAILURE

THE FAILURE MODE OF CONCERN FOR ELASTOMERIC SNUBBER SEALS IS FAILURE TO MAINTAIN A LOW PRESSURE FLUID CONTAINMENT BOUNDARY DURING NORMAL OPERATION WHEN THE SNUBBER IS DEACTIVATED.

THE ELASTIC FORCE GENERATED BY A COMPRESSED SEAL RELAXES WITH TIME.

THE RELAXATION RATE IS ACCELERATED BY HEAT AND RADIATION.

FOR SNUBBER SEALS, THE SERVICE LIFE ENDS WHEN THE SEAL'S ELASTIC FORCE IS NO LONGER SUFFICIENT FOR RELIABLE LOW PRESSURE SEALING.

OM CODE REQUIREMENTS FOR SERVICE LIFE MONITORING

- ESTABLISH AN INITIAL SERVICE LIFE
- REEVALUATE SERVICE LIFE BETWEEN EACH OUTAGE
- OPTIONS WHEN APPROACHING THE END OF SERVICE LIFE:
 - OVERHAUL
 - REPLACE
 - EXTEND SERVICE LIFE

INITIAL SERVICE LIFE

THE INITIAL SERVICE LIFE ASSIGNED TO A PLANT SNUBBER POPULATION IS TYPICALLY THE GENERIC SERVICE LIFE RECOMMENDED BY THE MANUFACTURER.

THE GENERIC SERVICE LIFE ESTABLISHED BY THE MANUFACTURER IS TYPICALLY BOUNDED BASED ON SPECIFIED MAXIMUM ALLOWABLE SERVICE CONDITIONS SUCH AS TEMPERATURE AND RADIATION LEVEL.

EXTENDING SERVICE LIFE

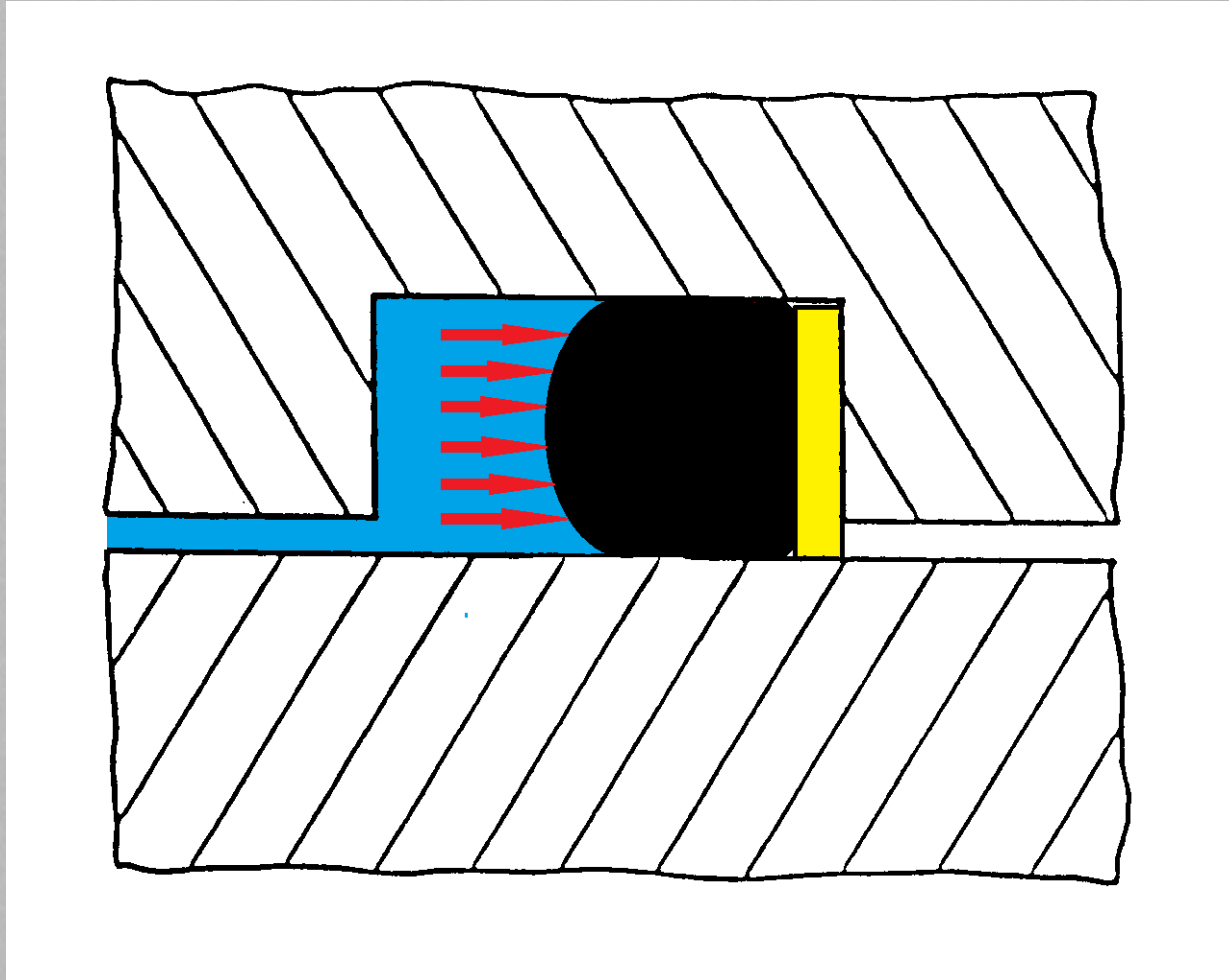
JUSTIFICATION FOR EXTENDING SERVICE LIFE BEYOND THE INITIAL VALUE IS TYPICALLY BASED ON PERMANENCE DATA ASSOCIATED WITH SEALS IN SNUBBERS THAT WERE EXPOSED TO THE APPLICABLE PLANT ENVIRONMENT FOR A PERIOD OF TIME THAT IS APPROACHING THE MANUFACTURER RECOMMENDED SERVICE LIFE.

SEALING EFFECTIVENESS

SEALING EFFECTIVENESS IS DIRECTLY RELATED TO THE INTERACTIVE FORCE BETWEEN THE SEAL AND ITS MATING SEALING SURFACE.

UNDER HIGH PRESSURE CONDITIONS WHEN THE SNUBBER IS ACTIVATED, THE INTERACTIVE SEALING FORCE IS ENHANCED BY THE PRESSURE APPLIED TO THE SEAL.

O-RING SEAL AT HIGH PRESSURE



SEALING EFFECTIVENESS

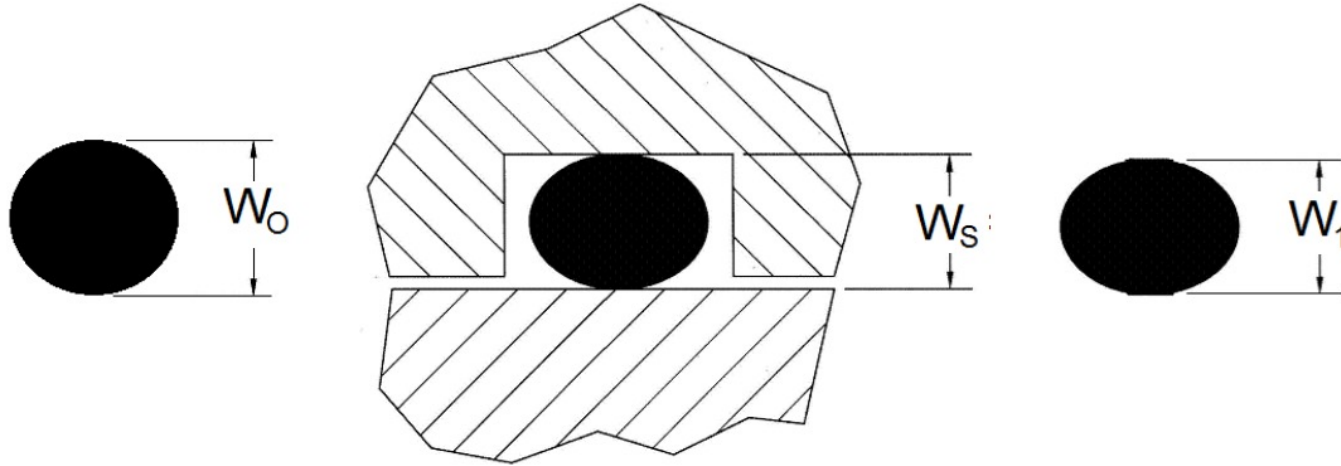
UNDER LOW PRESSURE CONDITIONS WHEN THE SNUBBER IS DEACTIVATED, THE SEAL MUST RELY SOLELY ON ITS ELASTIC ENERGY TO PROVIDE THE NECESSARY SEALING FORCE.

A SEAL'S ELASTIC ENERGY IS AT ITS HIGHEST LEVEL WHEN IT IS INITIALLY INSTALLED DURING SNUBBER ASSEMBLY.

THE SEAL'S ELASTIC ENERGY PROGRESSIVELY DECAYS THEREAFTER DUE TO STRESS RELAXATION.

A SEAL'S RELAXATION LEVEL IS DIRECTLY RELATED TO ITS COMPRESSION SET VALUE.

COMPRESSION SET



Original Thickness

100 mils

Compressed Thickness

75 mils

Recovered Thickness

90 mils

$$\text{Squeeze} = W_O - W_S = 100 - 75 = 25 \text{ mils}$$

$$\text{Set} = W_O - W_1 = 100 - 90 = 10 \text{ mils}$$

$$\text{Compression Set (C)} = \frac{\text{Set}}{\text{Squeeze}} = \frac{(W_O - W_1)}{(W_O - W_S)} = \frac{10}{25} = 40\%$$

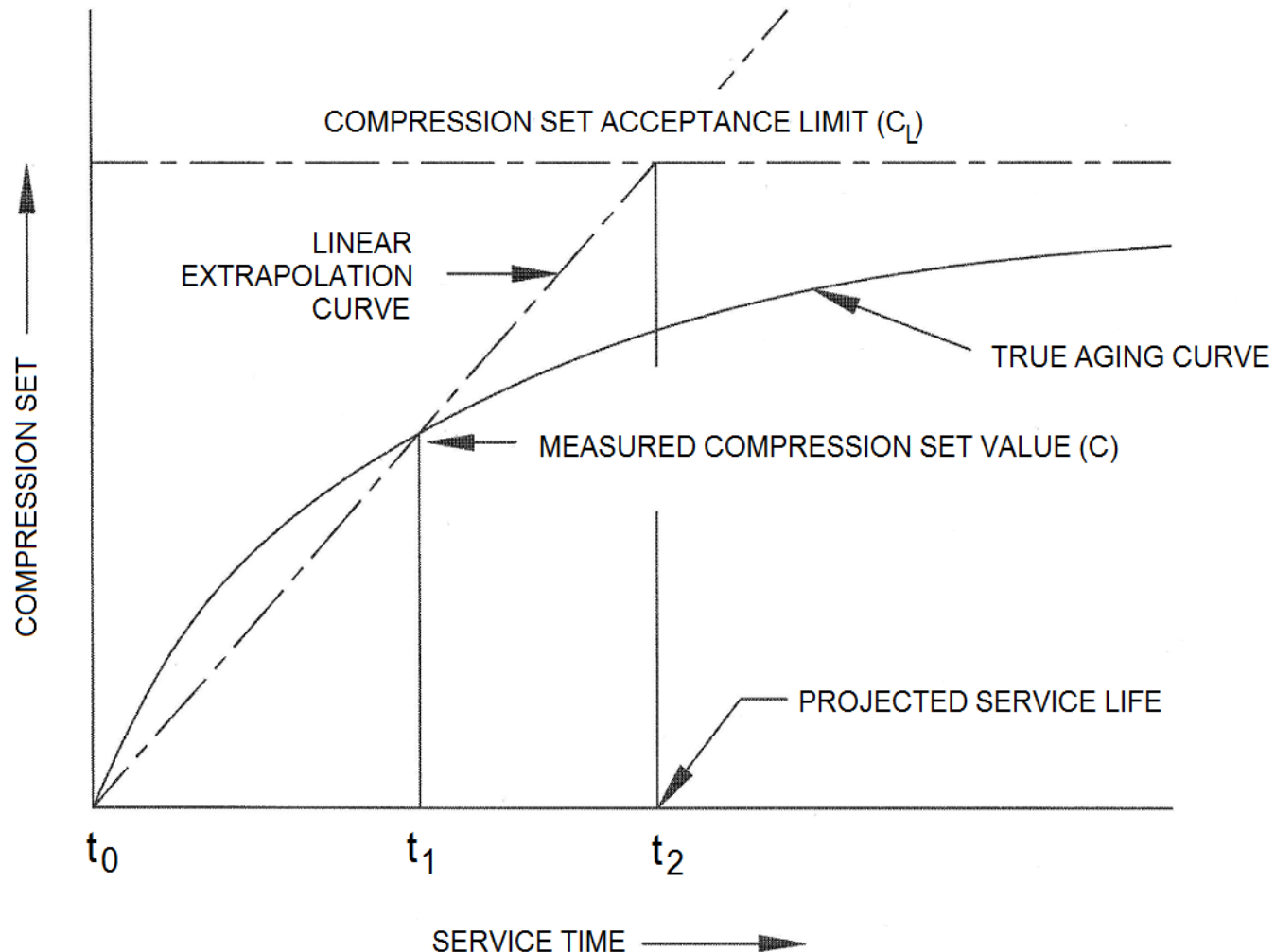
EXTENDING SERVICE LIFE

A SEAL'S RELAXATION LEVEL IS DIRECTLY RELATED TO ITS COMPRESSION SET VALUE.

IF $C = 0\%$, THE SEAL'S ELASTIC ENERGY IS THE SAME AS IT WAS WHEN THE SEAL WAS COMPRESSED DURING INSTALLATION.

IF $C = 100\%$, THE SEAL HAS COMPLETELY RELAXED AND ITS SEALING FORCE IS ZERO.

EXTENDING SERVICE LIFE



$$t_2 = \frac{C_L}{C} \times t_1 \quad \text{where} \quad \begin{array}{l} t_1 = \text{time in service} \\ t_2 = \text{projected seal life} \end{array}$$

LISEGA SNUBBERS AT HOPE CREEK STATION

IN THE THIRD QUARTER OF 1997 A TOTAL OF 66 LISEGA SNUBBERS OF VARIOUS SIZES WERE INSTALLED AT HOPE CREEK STATION.

BASED ON DOUCMENTATION PROVIDED BY LISEGA, A SEAL SERVICE LIFE OF 21 YEARS WAS ASSIGNED TO EACH OF THE INSTALLED SNUBBERS WHICH MEANS THAT THE SERVICE LIFE OF EACH SNUBBER WOULD EXPIRE IN THE THIRD QUARTER OF 2018.

CONSEQUENTLY THE SNUBBERS WOULD NEED TO BE REFURBISHED OR REPLACED OR THEIR SERVICE LIFE WOULD NEED TO BE EXTENDED PRIOR TO THE THIRD QUARTER OF 2018.

SEAL LIFE EVALUATION SAMPLES

A TOTAL OF EIGHT SNUBBERS OF VARIOUS SIZES WERE SELECTED AS REPRESENTATIVE SAMPLES TO BE REMOVED FROM SERVICE AND USED AS SAMPLES IN REEVALUATING THE SERVICE LIFE OF THE SUBJECT POPULATION.

THE EVALUATION SNUBBERS WERE REMOVED FROM SERVICE IN APRIL 2012 AFTER HAVING BEEN IN SERVICE FOR APPROXIMATELY 14.5 YEARS.

THE SNUBBERS WERE SUBSEQUENTLY VISUALLY EXAMINED BY LAKE ENGINEERING COMPANY AND FUNCTIONALLY TESTED BY PSEG.

ISOLATED SNUBBER LOCATION

IN THE COURSE OF CONDUCTING THE SEAL LIFE EVALUATION, A DEGRADED MODEL 3093 LISEGA SNUBBER WAS IDENTIFIED.

THE SNUBBER HAD BEEN REMOVED FROM SERVICE AFTER HAVING BEEN INSTALLED ON THE MAIN STEAM SYSTEM FOR 14.5 YEARS.

FOLLOWING DISASSEMBLY THE SNUBBER'S INTERNAL COMPONENTS WERE FOUND TO BE SEVERELY DEGRADED DUE TO WEAR RESULTING FROM SYSTEM VIBRATION.

CONSEQUENTLY, A SERVICE LIFE SHORTER THAN 14.5 YEARS WAS ASSIGNED FOR LISEGA SNUBBERS INSTALLED AT THIS LOCATION.

SEAL LIFE EVALUATION SAMPLES

FOLLOWING TESTING, THE EVALUATION SNUBBERS WERE DISASSEMBLED BY PSEG AND KEY DIMENSIONS ASSOCIATED WITH THE SEAL GLANDS WERE MEASURED BY LAKE ENGINEERING IN ORDER TO DETERMINE THE COMPRESSED THICKNESS (W_s) OF THE SEALS AFTER THEY WERE INSTALLED.

THE RECOVERED THICKNESS (W_1) AND HARDNESS OF EACH SEAL WAS THEN MEASURED.

BASED ON THE DATA OBTAINED, THE COMPRESSION SET VALUE FOR EACH SEAL WAS THEN CALCULATED.

MAXIMUM COMPRESSION SET VALUES (%)

Item No.	Snubber Serial Number							
	61368/59	61368/60	61369/90	61369/117	61355/12	61355/14	61373/65	61373/73
2	33	36	37	34	20	20	6	0
4	43	41	4	18	9	16	25	16
6	0	0	10	12	4	0	29	25
7	16	21	26	24	3	0	23	18
9	11	11	N/A	N/A	N/A	N/A	N/A	N/A
10	13	13	N/A	N/A	N/A	N/A	N/A	N/A
11	17	17	N/A	N/A	N/A	N/A	N/A	N/A
12	6	14	20	16	24	28	17	22
13	21	17	41	44	16	39	21	17
24	N/A	N/A	16	16	20	20	32	24
25	N/A	N/A	31	35	22	19	12	0
26A	N/A	N/A	15	25	3	0	23	16
26B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	8	7	19	43	19	10
28	N/A	N/A	45	50	28	28	38	30
29	N/A	N/A	52	47	28	25	20	7

PROJECTED SERVICE LIFE (YEARS)

Item No.	Snubber Serial Number							
	61368/59	61368/60	61369/90	61369/117	61355/12	61355/14	61373/65	61373/73
2	35.6	31.8	31.2	34.0	57.9	57.8	192.0	*
4	27.2	28.3	308.2	65.2	123.5	74.0	46.5	70.4
6	*	*	116.3	97.0	315.4	*	39.7	45.7
7	70.2	55.4	45.6	48.5	332.7	*	49.9	65.1
9	101.4	116.9	N/A	N/A	N/A	N/A	N/A	N/A
10	104.3	103.9	N/A	N/A	N/A	N/A	N/A	N/A
11	78.2	77.9	N/A	N/A	N/A	N/A	N/A	N/A
12	208.5	90.9	65.4	83.0	55.3	46.8	78.5	58.6
13	61.9	77.9	31.8	29.5	82.5	33.5	62.2	78.1
24	N/A	N/A	81.1	79.9	65.1	65.1	41.1	55.3
25	N/A	N/A	41.6	37.7	58.6	66.9	111.3	*
26A	N/A	N/A	88.3	51.5	455.7	*	58.0	83.3
26B	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	170.1	196.5	69.4	30.4	68.7	136.7
28	N/A	N/A	29.0	26.2	46.3	46.3	34.9	43.0
29	N/A	N/A	25.1	27.7	46.3	52.1	64.4	192.0

* Calculated compression set was insignificant or zero.

PROJECTED SERVICE LIFE

A SERVICE LIFE OF 25.1 YEARS WAS ESTABLISHED FOR ALL LOCATIONS AT WHICH LISEGA SNUBBER ARE INSTALLED WITH THE EXCEPTION OF THE LOCATION FROM WHICH THE DEGRADED MODEL 3093 SNUBBER WAS REMOVED AS WELL AS ANY OTHER SNUBBER LOCATIONS THAT ARE SUBJECT TO A SIMILAR LEVEL OF VIBRATION.

FOLLOW UP EVALUATION

**ANOTHER SAMPLE OF EIGHT HOPE CREEK
SNUBBERS WITH OVER 22 YEARS OF SERVICE
TIME WERE REMOVED FROM SERVICE IN
OCTOBER OF 2019 FOR USE IN A FOLLOW UP
EVALUATION IN AN EFFORT TO FURTHER
EXTEND THE SERVICE LIFE OF THE HOPE CREEK
LISEGA SNUBBER POPULATION.**

MAXIMUM COMPRESSION SET VALUES (%)

Item No.	Snubber Serial Number							
	61368/47	61320/95	61360/61	61380/30	61380/77	61355/125	61373/20	61373/57
2	53	43	34	35	49	7	15	18
4	40	30	34	12	29	9	36	25
6	11	31	4	24	38	0	31	23
7	24	32	13	22	36	0	14	21
9	15	52	31	N/A	N/A	N/A	N/A	N/A
10	31	59	N/A	N/A	N/A	N/A	N/A	N/A
11	28	38	N/A	N/A	N/A	N/A	N/A	N/A
12	43	43	50	43	53	37	28	24
13	28	29	44	29	47	21	21	15
24	N/A	N/A	32	28	45	26	38	24
25	N/A	N/A	34	25	53	27	20	27
26A	N/A	N/A	33	33	44	14	25	6
26B	N/A	N/A	25	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	46	38	31	27	24	18
28	N/A	N/A	N/A	31	55	16	20	13
29	N/A	N/A	N/A	38	58	10	7	3

PROJECTED SERVICE LIFE (YEARS)

Item No.	Snubber Serial Number							
	61368/47	61320/95	61360/61	61380/30	61380/77	61355/125	61373/20	61373/57
2	33.0	40.5	51.3	50.0	36.2	250.7	115.9	97.3
4	44.0	58.0	51.9	152.2	61.6	187.7	48.6	71.8
6	153.1	57.4	404.9	73.2	45.9	*	56.1	75.5
7	71.9	55.7	137.1	81.2	48.6	*	122.9	82.9
9	135.3	37.8	64.4	N/A	N/A	N/A	N/A	N/A
10	63.4	33.6	N/A	N/A	N/A	N/A	N/A	N/A
11	71.3	51.4	N/A	N/A	N/A	N/A	N/A	N/A
12	46.2	46.2	39.6	46.1	37.6	53.7	71.1	84.6
13	71.3	67.3	45.3	67.2	41.8	94.0	93.8	132.7
24	N/A	N/A	61.1	71.6	43.9	74.8	51.7	83.4
25	N/A	N/A	57.8	79.0	37.1	73.0	100.4	74.7
26A	N/A	N/A	60.5	59.3	44.6	136.6	77.8	308.6
26B	N/A	N/A	77.8	N/A	N/A	N/A	N/A	N/A
27	N/A	N/A	42.9	51.4	64.4	72.6	82.9	109.5
28	N/A	N/A	N/A	62.9	36.1	124.7	98.7	149.3
29	N/A	N/A	N/A	51.7	33.9	207.8	291.3	587.3

* Calculated compression set was insignificant or zero.

OVERVIEW

TO DATE LAKE ENGINEERING HAS CONDUCTED A TOTAL OF EIGHTY THREE SIMILAR SEAL LIFE EVALUATIONS FOR SNUBBER POPULATIONS AT VARIOUS PLANTS.

AFTERNOON BEVERAGE BREAK

SPONSORED BY



RETURN BY 3:00 PM



ASC-ES SF-N HYDRAULIC SNUBBER FLUID

ASC-ES SF-N HYDRAULIC FLUID

- ASC-ES offers two approved silicone hydraulic snubber fluids under SF-N.
- SF-N includes SF-1154 and SF-1143
- The two fluids are readily mixable.
- Over decade ago, ASC-ES has benchmarked SF-1143 against SF-1154 for viscosity, bulk modulus, thermal expansion and radiation resistance up to 200 Mrads.
- SF-N is certified to a shelf life of 5 years.

BENEFITS OF SF-1143

- More than 50% reduction in snubber fluid cost
- No history of precipitate formation in SF-1143 fluid
- No change in fluid performance or snubber reliability

COMPARISON OF SF-1143 TO SF-1154

Properties	SF-1154	SF-1143
Viscosity (cSts)	150-200	150-200
Effect of 40 Mrad Radiation	No gelation	No gelation
Coefficient of Thermal Expansion @ 300°F (in ³ /in ³ /°F)	.00042	.00042
Bulk Modulus – Secant @ 10,0000 (psi)	244,000	240,000
Specific Gravity	1.08	1.08
Flash Point	> 500 °F	> 500 °F

QUALIFICATION OF SF-1143 SILICONE FLUID

- Radiation testing of this dimethyldiphenylpolysiloxane silicone fluid has been performed at 15, 30, 40, 125 and 200 M rads.
- Compatibility with E.P. compounds has been performed at 40 and 200 M rads.
- Compatibility with SF-1154 silicone fluid has been performed at 40 M rads.

RESULTS OF SF-1143 SILICONE FLUID TESTING

- Radiation testing through 125 M rads of this silicone fluid shows a minimal change in viscosity paralleling that of the SF-1154 samples included in the test. Additional testing to 200 M rads showed no gelation.
- E.P. compounds immersed in SF-1143 showed no evidence of swelling through 200 M rads.
- SF-1143 was shown to be miscible with SF-1154 silicone fluid through 40 M rads.

CONCLUSIONS REGARDING SF-1143 SILICONE FLUID

- SF-1143 has the same excellent resistance to radiation as SF-1154
- SF-1143 and SF-1154 have the same physical properties.
- SF-1143 is completely compatible with E.P. seals.
- SF-1143 is completely compatible with SF-1154
- SF-1143 is approved for use in Anvil snubbers.
- If SF-N fluid is specified on a Purchase Order SF-1143 will be supplied (unless SF-1154 is specified).

2024 Snubber SNUG Conference

Nate Frank
AEP -Cook Nuclear Plant

JULY 15, 2024



COOK PLANT

SAFETY MOMENT

TBD



COOK PLANT

ANVIL FIGURE 201N CONFIG A



BACKGROUND

Cook has hundreds of ANVIL Figure 201N Config A Snubbers

- *Initial Plant started with Adjustable Standard Lexan*
- *Many with Remote Reservoirs*
- *Have since upgraded all to CONFIG A*
- *Small Bore Snubber Population*
- *Rebuild & Test in house*



First Impressions after review of pictures

Facts of this Snubber:

- *Anvil Config A*
- *Installed since 2002*
 - *Service Life of 22 years*
- *Utilized SF 1154*
 - *Believed to be GE SF 1154*
 - *Industry question*
 - *When did suppliers switch?*
- *Used on Main Steam line*
- *Service Life was reduced from 25 to 22 years post prior outage*





INDIANA
MICHIGAN
POWER

COOK PLANT

an AEP Company



INDIANA
MICHIGAN
POWER

COOK PLANT

an AEP Company

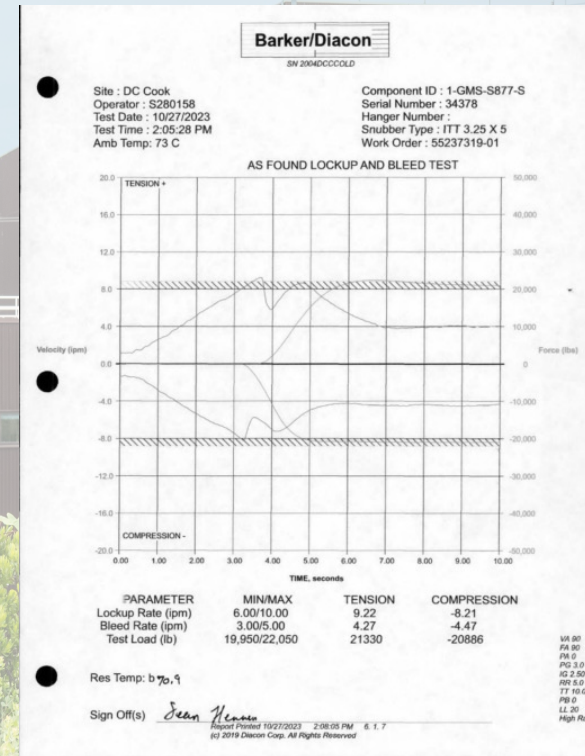
Thoughts?



COOK PLANT

Functional Test Results

- Functional Test Performed Prior to disassembly
- Barker-Diacon Test Bench
- Mechanical Maintenance Personnel
- Yep IT PASSED!



KEY TAKEAWAYS

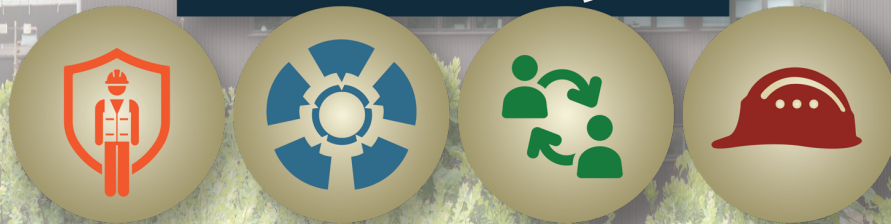
- Bleed and Lockup Rates were acceptable
- Robust, Well-Designed Valving
- SN 34378 was manufactured 40+ years ago,
 - Upgraded in 2000
 - Used a Configuration A upgrade
 - 100% Config A at Cook
 - Opportunity for Industry to reduce Life Cycle Costs



QUESTIONS?



Be Excellent *Today*

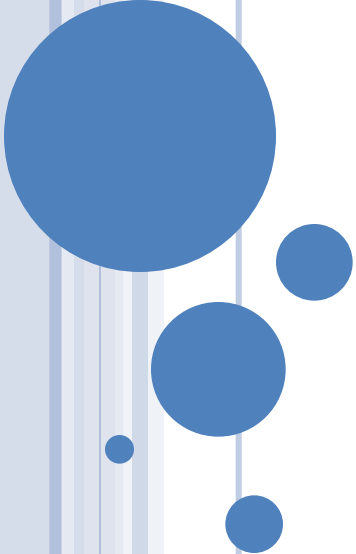


QUESTION CARDS ???



Business Meeting

SNUBBER USERS GROUP, INC. 2024 BUSINESS MEETING



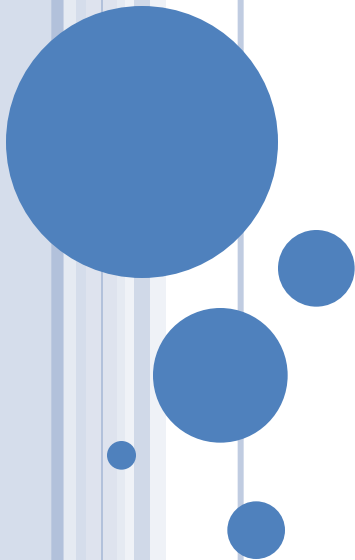
Scott Esposito

President & Chairman of BOD

Business Meeting

ROLL CALL

SUMMER 2024



CURRENT ACTIVE MEMBER PLANTS



- Arkansas Nuclear One
- Beaver Valley
- Braidwood
- Browns Ferry
- Brunswick
- Byron
- Callaway
- Calvert Cliffs
- Catawba
- Cernavoda
- Clinton
- Columbia
- Comanche Peak
- Cook
- Cooper
- Davis-Besse
- Diablo Canyon
- Dresden
- Farley
- Fermi
- FitzPatrick
- Ginna
- Grand Gulf
- Harris
- Hatch
- Hope Creek (expires 07/24)
- Krsko
- LaSalle
- Limerick
- McGuire
- Millstone
- Monticello
- Nine Mile
- North Anna
- Oconee
- Palo Verde
- Peach Bottom
- Perry
- Point Beach
- Prairie Island
- Quad Cities
- River Bend
- Robinson
- Salem (expires 07/24)
- Seabrook
- Sequoyah
- South Texas
- St. Lucie
- Summer
- Surry
- Susquehanna
- Vogtle
- Waterford
- Watts Bar
- Wolf Creek



Current SNUG Board of Directors

Terms expiring 2024	Tim Canter John Catano Nate Frank Steve Norman
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Terms expiring 2025	Ed Dundon Mitch Etten-Bohm Mario Mazzuca (resigned, no replacement yet) Marissa Post (resigned, AP Smith to be appointed)
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Terms expiring 2026	Gus Avila Scott Esposito Bob Fandetti Stephanie McCormick
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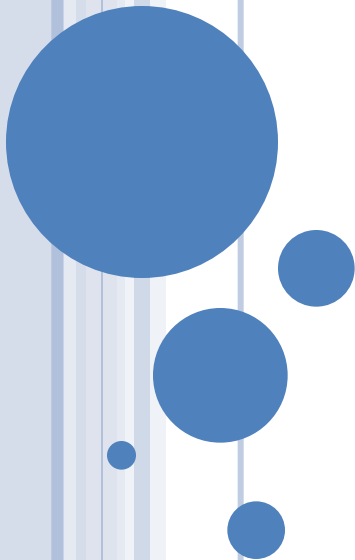
Business Meeting

INTRODUCTION OF NOMINEES

Scott Esposito

President & Chairman of BOD

2024 - 2027 Terms



SNUG Board of Directors Nominees

- **Tim Canter**
- **Nate Frank**
- **Steve Norman**
- **Jeff Stallman**

Up to four candidates may be voted for.

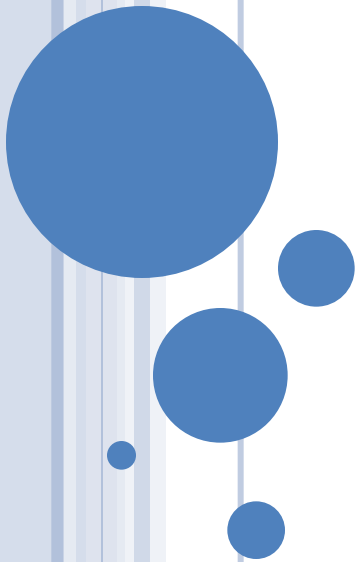
One ballot per member site.

Top four elected regardless of number of votes.



Business Meeting

ELECTION OF DIRECTORS





SNUBBER USERS GROUP

Current Financial Status

Presented by Steve Norman

SNUG Treasurer & Chief Financial Officer

Summer 2024 Conference & Trade Show

July 15, 2024

Status as of January 1, 2024

- Account Balances

- Checking Account \$ 28,340.46
- Money Market Account \$ 25,734.85

Total \$ 54,075.31

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Current Status

Beginning Balance	\$ 54,075.31
Expenditures	\$ 19,291.37
Income	\$ 39,667.24
Current Total	\$ 74,451.18

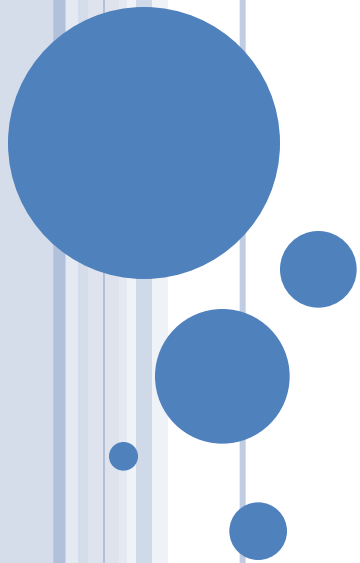
SNUBBER USERS GROUP

Current Financial Status



Business Meeting

ELECTION RESULTS



Business Meeting

ELECTION RESULTS

Your New Directors for 2024 – 2027 are:

- **Tim Canter**
- **Nate Frank**
- **Steve Norman**
- **Jeff Stallman**

Business Meeting

ADJOURN SNUBBER USERS GROUP, INC. 2024 BUSINESS MEETING

Scott Esposito

President & Chairman of BOD

DAILY ADJOURNMENT

BUSES LEAVE FOR ROCK AND ROLL HALL OF FAME AT
5:30 PM

DON'T BE LATE

TUESDAY'S SESSION BEGINS
8:00 AM

