SAND2021-13977C

Sandia National Laboratories is a multimission laboratory managed and operated by National Technology & Engineering Solutions of Sandia, LLC, a wholly owned subsidiary of Honeywell International Inc., for the U.S. Department of Energy's National Nuclear Security Administration under contract DE NA0003525.

ANS PSA 2021
2021 International Topical Meeting on
Probabilistic Safety Assessment and Analysis

SODIUM FILTER PERFORMANCE IN THE NaSCoRD DATABASE

Presented By: Jamal Mohmand
Co-Author: Andrew Clark
Sandia National Laboratories

Background

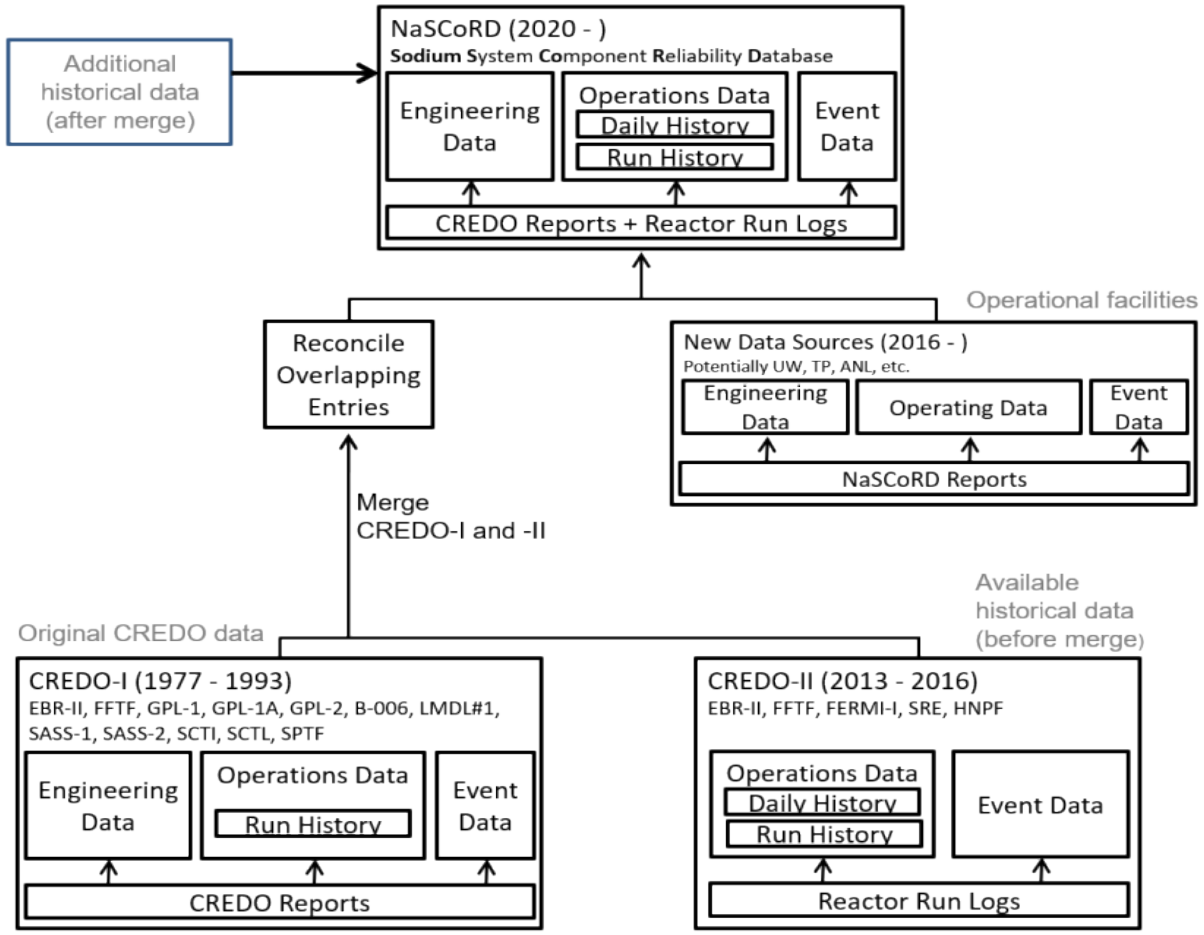


Figure 1. NaSCoRD Data Sources and Flow

Reactors in NaSCoRD

Reactor Name	Acronym
Experimental Breeder Reactor 2	EBR-II
Fast Flux Test Facility	FFTF
FERMI-I Nuclear Power Facility	FERMI-1
General Purpose Loop 1	GPL-1
General Purpose Loop 1A	GPL-A1
General Purpose Loop 2	GPL-2
Liquid Metal Development Lab 1	LMDL#1
Small Components Test Loop	SCTL
Sodium Auxiliary Supply System 1	SASS-1
Sodium Auxiliary Supply System 2	SASS-2
Sodium Components Test Installation	SCTI
Sodium Laboratory	B-006
Sodium Pump Test Facility	SPTF

Motivation

Knowledge Management and Preservation

- US operational data from reactors and test loops was lost.
- In 2016, JAEA transferred the US portion of the Centralized Reliability Data Organization (CREDO) database back to the US.

Future test complex insights

- New loops may use similar components to those used in the historical facilities and can learn from their experiences.

Probabilistic Risk Assessment (PRA) support

- CREDO data was used to support MONJU, PRISM, and EBR-II PRAs.
- This data can be a valuable resource to future SFR PRAs.

Data Types in NaSCoRD

- Event Data – Descriptive information about failure events (2702)
- Engineering Data – Specific component operational history and run time (8102)
- Operating Data – Reactor operational history (408)
- Images – Pictures of components (145)

*Parenthesis represent number of records in the database

Component Types

Mechanical	Electrical	Instrumentation and Control	Passive
Control Rod Drive Mechanism	Electric Bus	Indicator	Cold and Vapor Trap
Gas Dryer	Electric Heater	Instrument Controller	Filter/Strainer
Gas Mover	Electromagnetic Pump	Mechanical Control Device	Heat Exchanger
Mechanical Pump	Generator	Nonnuclear Sensor	Penetrations
Motor	Power Supply	Nuclear Detector	Pipe and Fittings
Rupture Device		Plugging Meter	Pressure Vesssel and Tanks
Turbine		Recorder	Support and Shock Devices
Valve		Signal Modifier	
		Signal Transmitter	

Methodology

- Identify Component Type of Interest
- Determine Number of Components
- Determine Number of Component Events
- Determine Operational Time of Each Component
- Calculate Failure Rate

Analysis

- Results can be displayed with different criteria
- Failure mode (Plugged, Leakage, All)
- Plant Operating State (Power Operations, Hot Standby)
- Reactor (Unit, Type, Size)
- Bayesian Updating can be applied (not done in this report)

Failure Rate by Reactor

Reactor	Total Filters	Filter Events	Filter Operating Hours (Power Ops)	Filter Operating Hours (Power Ops+Hot Standby)	Failure Rate (Power Ops)	Failure Rate (Power Ops+Hot Standby)
GPL-2	1	0	1.63E+04	2.38E+04	N/A	N/A
LMDL-1	1	0	2.27E+03	8.76E+03	N/A	N/A
SCTI	1	0	5.38E+03	3.27E+04	N/A	N/A
SCTL	1	0	1.15E+03	1.13E+04	N/A	N/A
SL-B-006	2	0	1.72E+03	2.23E+04	N/A	N/A
EBR-II	20	6	1.71E+06	2.40E+06	3.5E-06	2.5E-06
FFTF	121	1	6.16E+06	6.59E+06	1.6E-07	1.5E-07

Failure Rate by Failure Mode

Failure Mode	Number of Events	Filter Operating Hours (Power Ops)	Filter Operating Hours (Power Ops+Hot Standby)	Failure Rate (Power Ops)	Failure Rate (Power Ops+Hot Standby)
PLUGGED	6	7.89E+06	9.09E+06	7.6E-07	6.6E-07
INTERNAL LEAK	1	7.88E+06	9.09E+06	1.3E-07	1.1E-07
COMBINED	7	7.87E+06	9.09E+06	8.9E-07	7.7E-07

Failure Rate Comparison

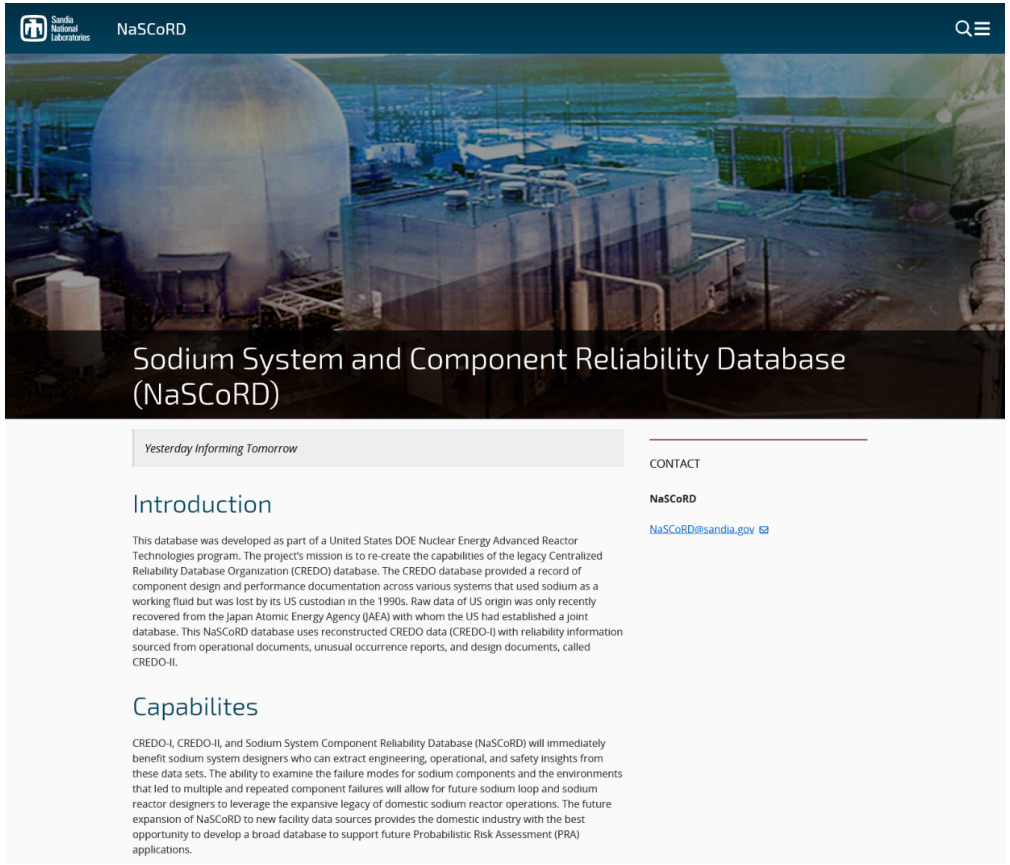
Reference	Source	Mode	Failure Rate	Reference Location	Failure Rate (Power Ops)	Failure Rate (Power Ops+Hot Standby)
EG&G Idaho [6]	Recommended	PLUGGED	3.0E-06	Table 2	7.6E-07	6.6E-07
EG&G Idaho [6]	CREDO	PLUGGED	2.8E-06	Table 9	1.3E-07	1.1E-07
LMEC Memo-69-7 [12]	N/A	ALL	3.57E-06	Table I-218	8.9E-07	7.7E-07

Conclusions

- NaSCoRD provides overall failure rates for Sodium Filters based on previous analysis and reports
- NaSCoRD not in alignment for PLUGGED failure mode
- FFTF had more filters and filter hours compared to EBR-II, but had less filter failure events
- Additional data and partnership to expand the database

Access to NaSCoRD

- NaSCoRD is access controlled. To request access, access www.sandia.gov/nascord.
- DOE, and SNL approvals are required before access is granted.
- NaSCoRD access is provided to external users via Microsoft SQL HTML reports.



Acknowledgements

This work is supported by Memorandum Purchase Order No. 00238401 from Battelle Energy Alliance, LLC operating Idaho National Laboratory under U.S. Government Contract No. DE-AC07-05ID14517for DOE-GAIN.