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SODIUM FILTER PERFORMANCE IN THE NaSCoRD DATABASE

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Background

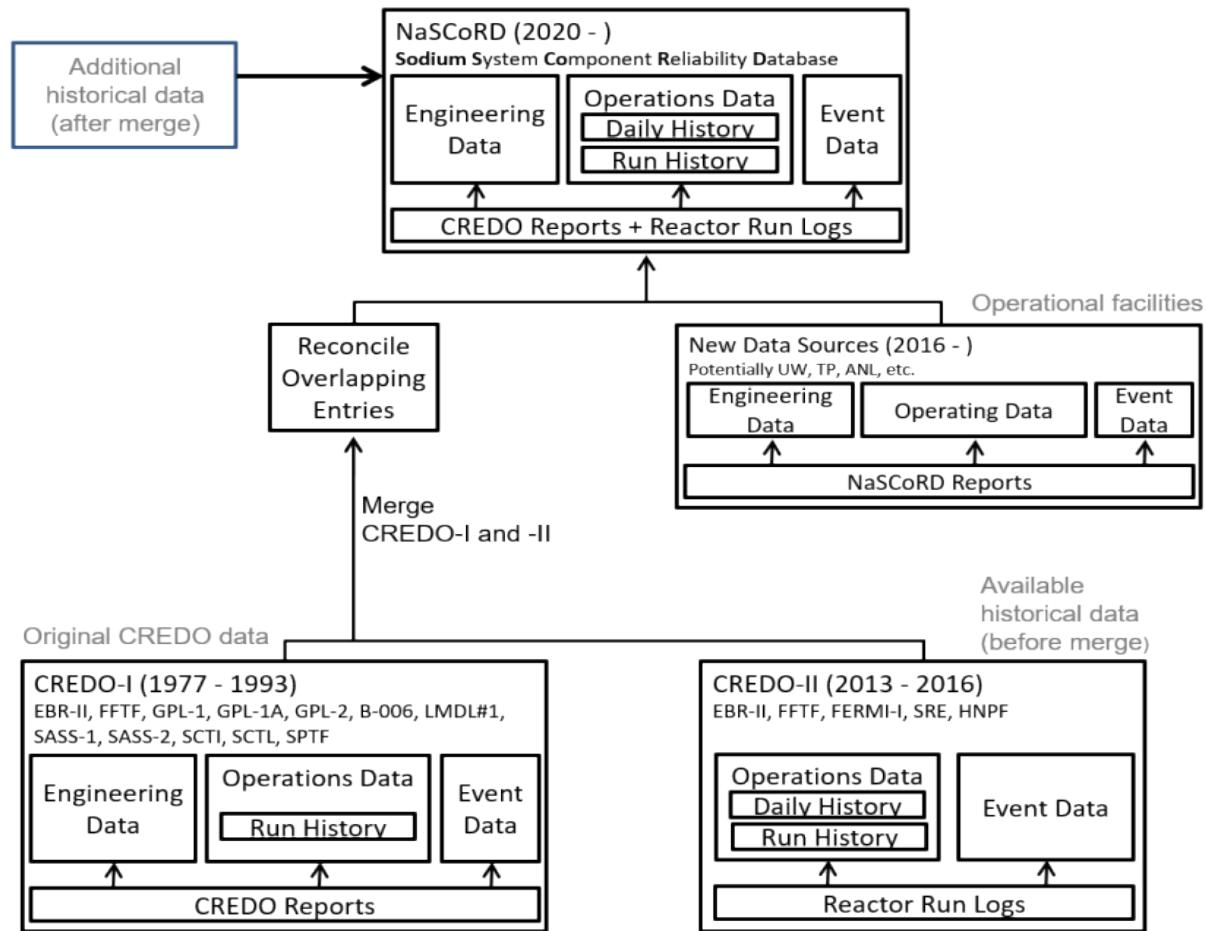


Figure 1. NaSCoRD Data Sources and Flow

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 Vessel 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.

Sodium System and Component Reliability Database (NaSCoRD)

Yesterday Informing Tomorrow

Introduction

This database was developed as part of a United States DOE Nuclear Energy Advanced Reactor Technologies program. The project's mission is to re-create the capabilities of the legacy Centralized Reliability Database Organization (CREDO) database. The CREDO database provided a record of component design and performance documentation across various systems that used sodium as a working fluid but was lost by its US custodian in the 1990s. Raw data of US origin was only recently recovered from the Japan Atomic Energy Agency (JAEA) with whom the US had established a joint database. This NaSCoRD database uses reconstructed CREDO data (CREDO-I) with reliability information sourced from operational documents, unusual occurrence reports, and design documents, called CREDO-II.

Capabilites

CREDO-I, CREDO-II, and Sodium System Component Reliability Database (NaSCoRD) will immediately benefit sodium system designers who can extract engineering, operational, and safety insights from these data sets. The ability to examine the failure modes for sodium components and the environments that led to multiple and repeated component failures will allow for future sodium loop and sodium reactor designers to leverage the expansive legacy of domestic sodium reactor operations. The future expansion of NaSCoRD to new facility data sources provides the domestic industry with the best opportunity to develop a broad database to support future Probabilistic Risk Assessment (PRA) applications.

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