



MOSARD: Molten Salt Reactors Reliability Database

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Why do we need component failure rate data?

Failure rate data is needed to quantify a probabilistic risk assessment (PRA), under the risk-informed performance-based licensing by the US Nuclear Regulatory Commission.

Another important use of component failure rate data is to support Reliability, Availability, Maintainability (RAM) analyses

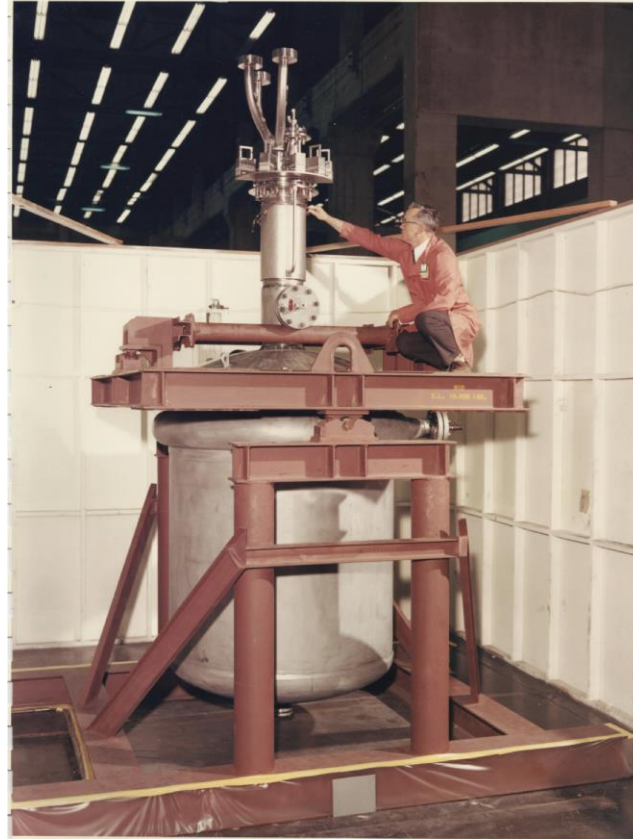
- to demonstrate the MSR test loops/ facilities availability

A third use is to support facility operations, including spare parts planning & maintenance intervals.

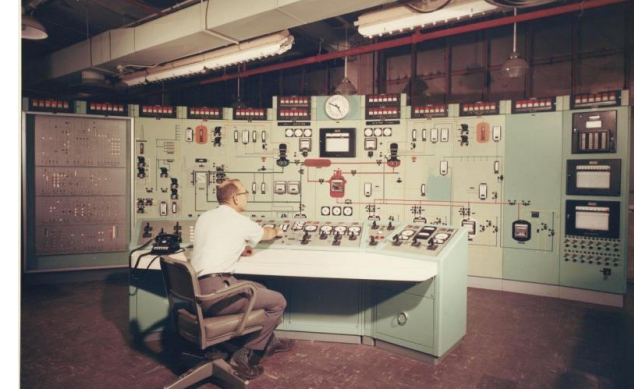
For lessons learned from 1960s and exchanging lessons NOW

Building capability to examine the failure modes of salt components that led to **multiple and repeated** component failures during the MSRE operations:

to improve reliability performance, the next generation of salt components, possibly reduce transients in the operations.



The MSRE Vessel



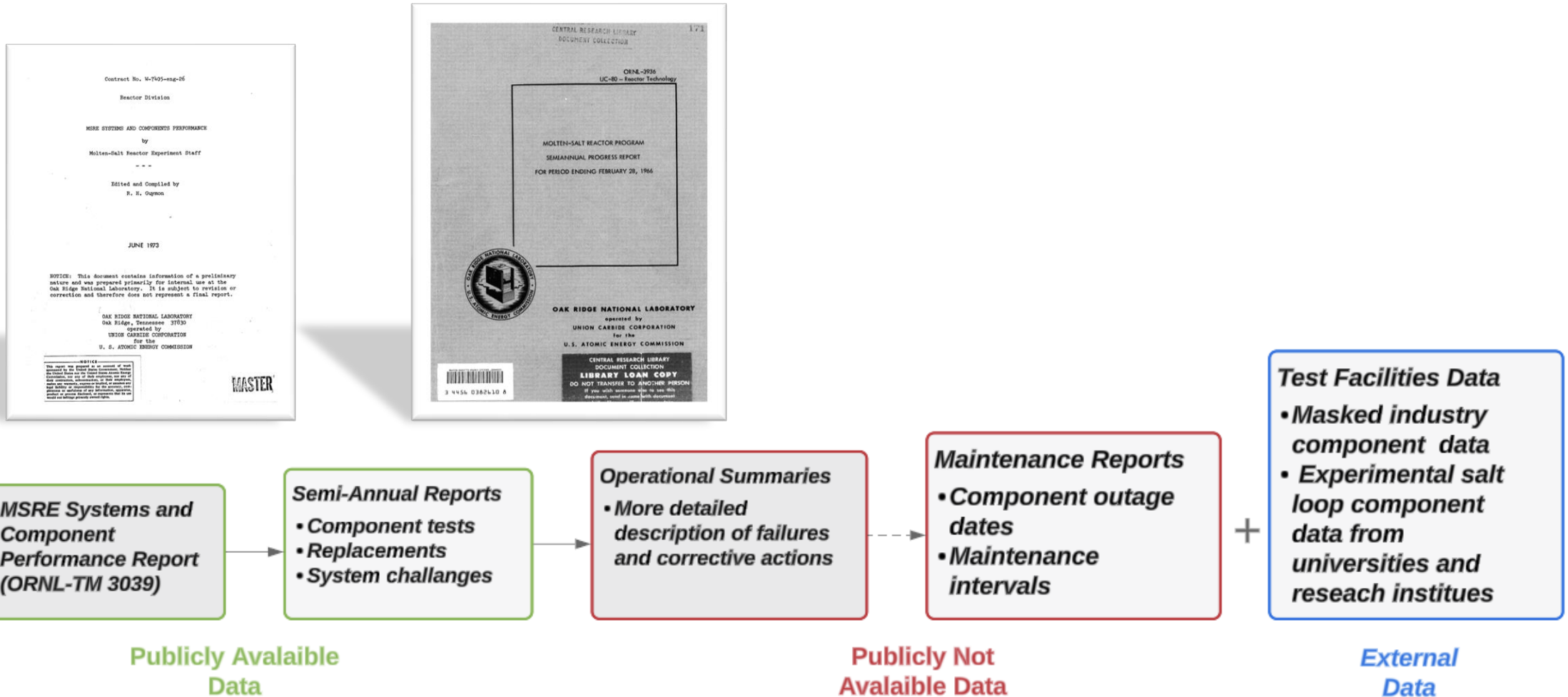
The MSRE Control Room Picture

Molten Salt Reactor Reliability Data Needs for PRA

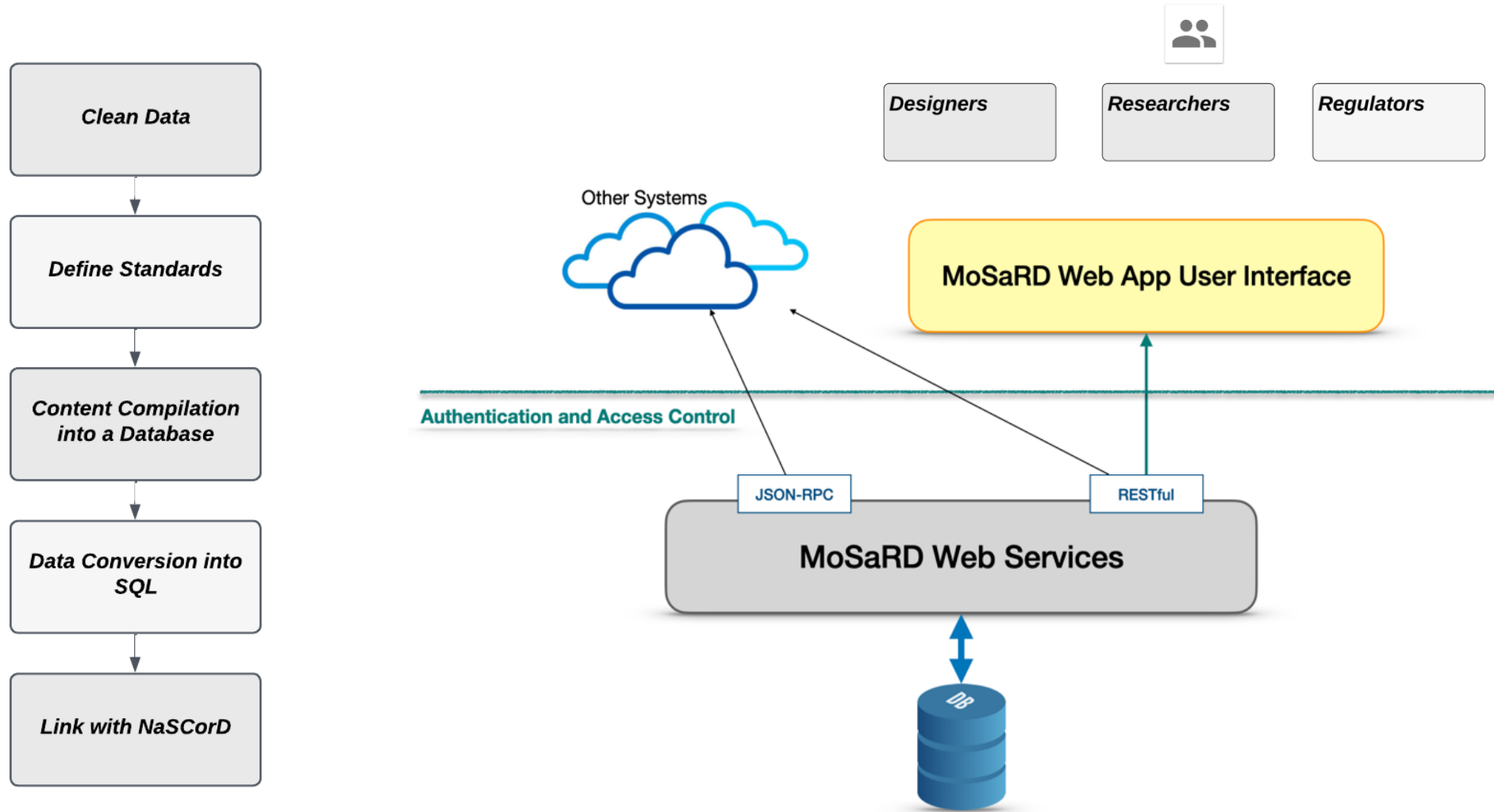


System name: Reactor and Primary Fuel Salt System	
IE ID	IE for radioactive releases
001	Spectrum of fuel salt boundary breach sizes and locations: <ul style="list-style-type: none"> Breaches with gas release only Breaches with gas and fuel salt release
002	Actuation of dump system with or without pre-existing leak in dump tank coolant boundary
003	Fuel salt freezing in heat exchanger (primary side plugged)
004	Plugging on secondary side of heat exchanger
005	Salt contamination/impurities
006	Spectrum of unanticipated foreign material buildup in the core
007	Improper fuel salt composition during loading to reactor system
008	Fuel pump over-speed / under-speed
009	Vapor lock of heat exchanger
010	Fuel salt freezing in primary fuel salt system
011	Undercooling/overcooling of heat exchanger
012	Inadvertent fuel pump trip
013	Fuel salt pump shaft shear/seizure
014	Fuel salt pump seal failure
015	Fuel salt pump shaft vibration due to its length
016	Inadvertent freeze valve opening
017	Change in core/primary fuel salt system void fraction too high or too low
018	Fuel salt pump cavitation
019	Excessive graphite radiation damage
020	Change in fuel salt volume in the primary fuel salt system
021	Core flow blockage
022	Change in core geometry

Database Input: Where to find and collect relevant data?



Data Process: How do we extract and preserve the data?



MOSARD Architecture

Initial Effort

- Building understanding on causes of failures that lead to premature replacement of **control and check valves** of off-gas, cover gas system.
- The incidents are systematically analyzed, translated and grouped according
 - type of component
 - type of failure
 - operational fluid
 - contributing factors
- Initial findings indicated that in MSRE valve issues related with plugging solved mostly with better filter designs and bigger size valve replacements. Trade-off study related with number, size, location (relative to the charcoal beds) and cost informs more reliable operations of the off-gas system.

Database GUI

Log in | Django site admin

MoSaRD

Source map errors — Fire

127.0.0.1:8000/mosard/event

Settings

127.0.0.1:8000/mosard/event/plot

credo_i
credo_ii
ornl

Component Subtype:

check
manual
pneumatic

Component Number:
0000-00-00
CV-528
CV-533
CV-560

valve

Failure Mode:
FTO
FTO/FTC
INTLEAK
N/A

Start Date:
mm / dd / yyyy

gas check
gas control

Outage Flag:
False
True

End Date:
mm / dd / yyyy

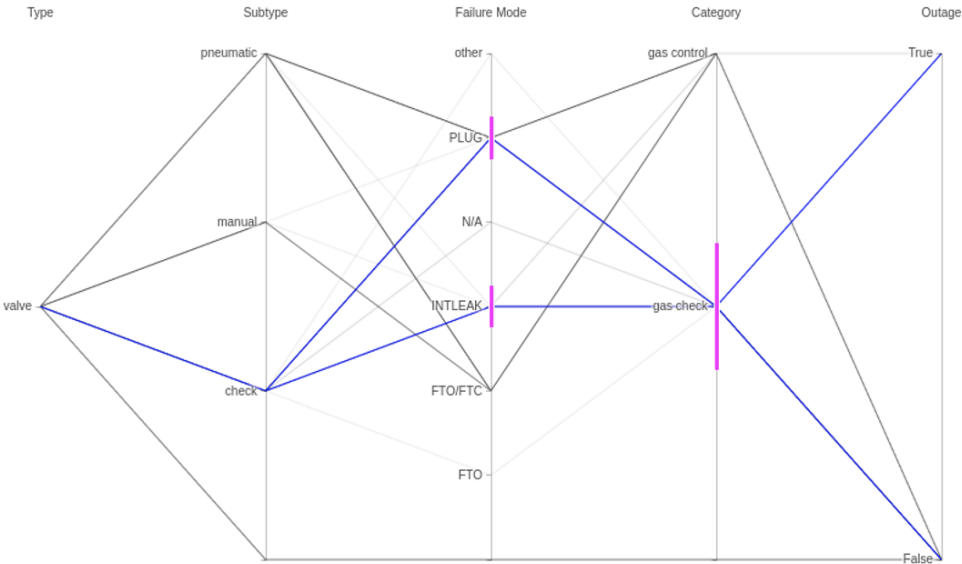
Apply

Reset

Search data...

Component Details

Search



Type	Failure Mode	Count
valve		491
valve	FTO	1
valve	FTO/FTC	14
valve	INTLEAK	6
valve	N/A	2
valve	PLUG	14
valve	other	1

Database Capabilities

- Options for the user to:
 - Search and select the failure data for a component
 - Estimate generic MSR design probability of failure on demand and failure rate, and the out-of- service unavailability
 - Prepare output reports of probability distributions and trends
 - Calculate initiating event frequencies
- PostgreSQL and a server for hosting it: VM (re7linux.ornl.gov).
- The prototype database structure and Web services interface for the MOSARD is finalizing migration to a new server.

Conclusion

- Supporting MSR system designers during Risk-Informed Performance-Based licensing
 - anticipated design justifications (component redundancy, sizes, etc.) the regulator may require.
- The operational experience database is needed post-statistic analysis, failure frequency estimates, trends, lessons learnt, and input for the probabilistic risk assessment (PRA) analysis.
- These failure data are valuable for– Reliability, availability and maintainability analyses and operations support.
- Focused data mining approach: What do designers need?

Acknowledgements

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Thank you!

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