INL/CON-24-77608

April 17th, 2024

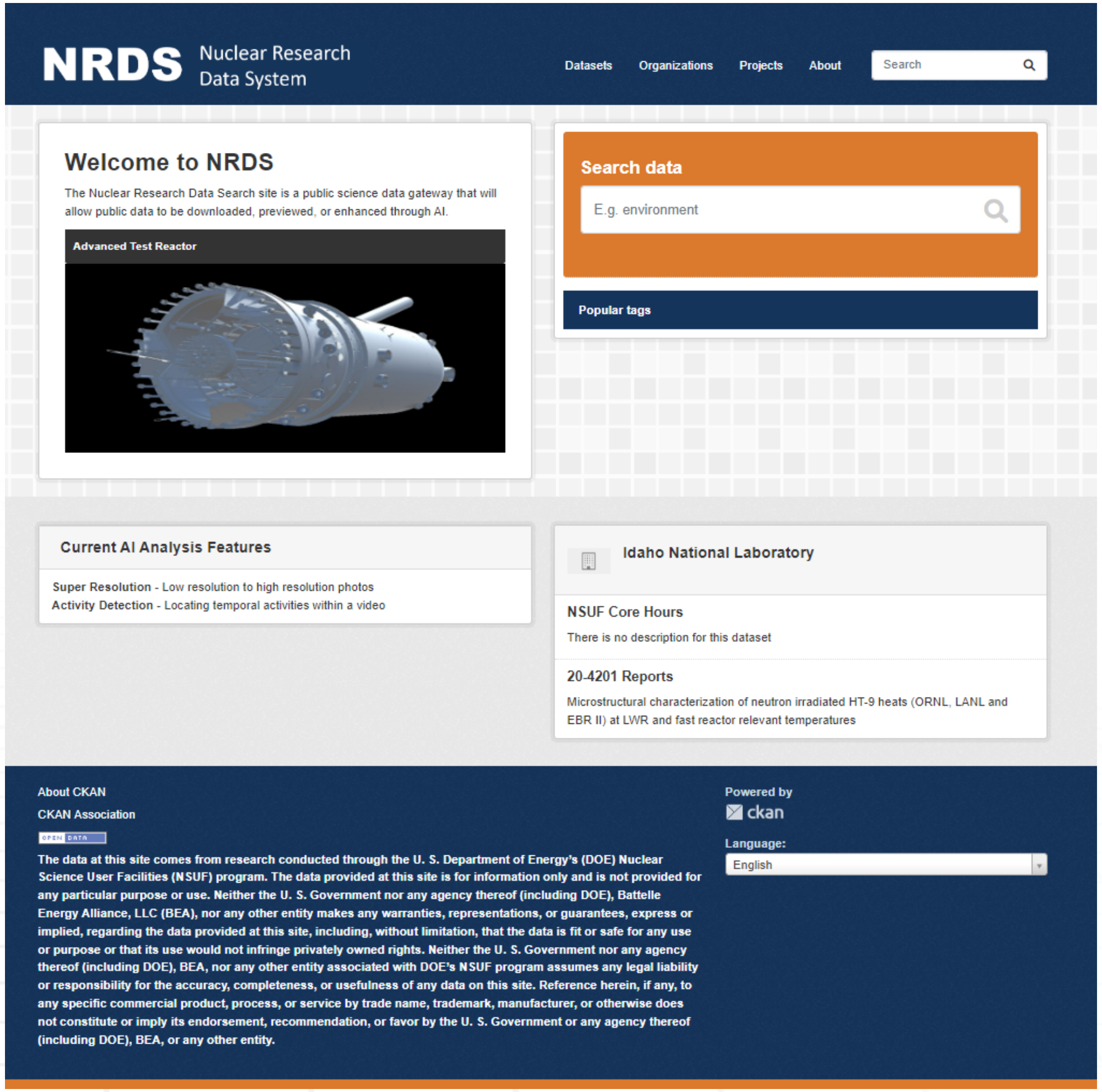
Bradlee Rothwell
HPC Website Developer
and System Administrator

Overview of the Nuclear Research Data System (NRDS)

Nuclear Science User Facilities

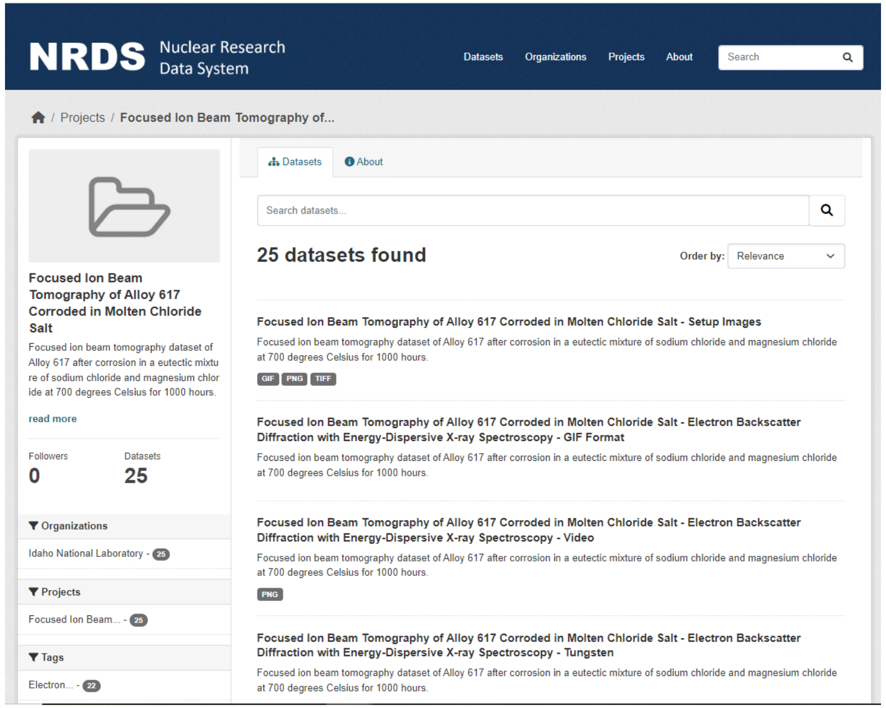
What is NRDS?

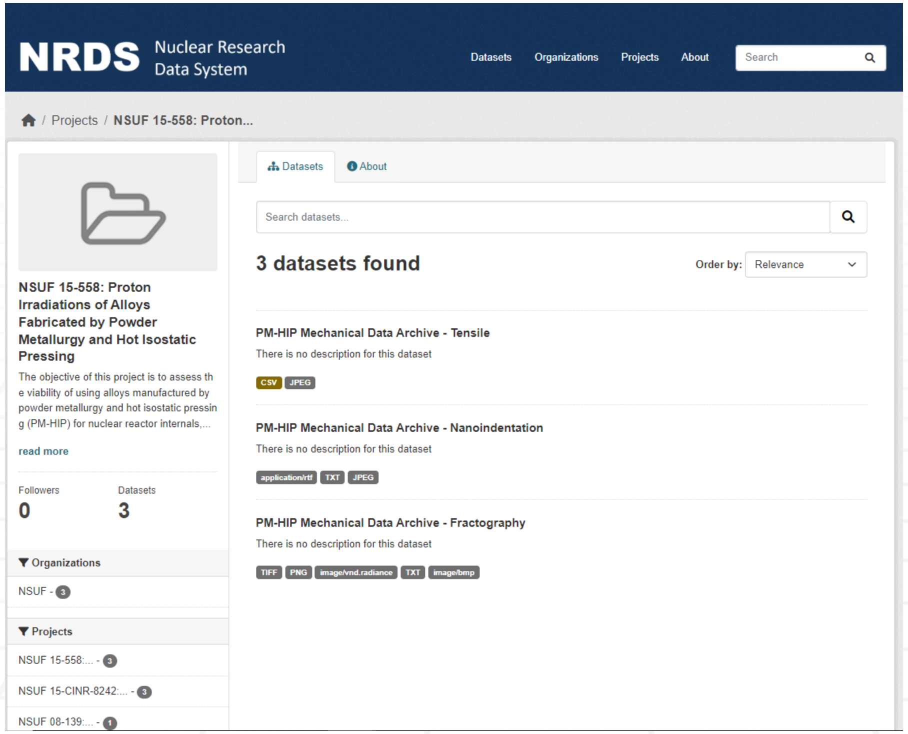
- Place for data to be:
  - Publicly available
  - FpAIRe
    - Findability
    - Peekable
    - Accessibility
    - Interoperable
      - Stored close to HPC systems
    - Reusable
    - Extensible
- Funded by the
  Nuclear Science User Facilities



Publicly Available Data

- Data co-located with projects
- Easy to find via search
- Traceable





Dataset Flow

NRDS

- License
- Type of data
- Author
- OSTI Link
- DOI Link

Projects / NSUF 15-8242: Irradiation...

NSUF 15-8242: Irradiation Influence on Alloys Fabricated by Powder Metallurgy and Hot Isostatic Pressing for Nuclear Applications)

Manufacturing processes have considerable influence over the safety and integrity of nuclear reactor vessels and internal components. Established processes such as casting,...

read more

Followers 0 | Datasets 5

Datasets | About | Activity Stream

NSUF 15-8242: Irradiation Influence on Alloys Fabricated by Powder Metallurgy and Hot Isostatic Pressing for Nuclear Applications)

Manufacturing processes have considerable influence over the safety and integrity of nuclear reactor vessels and internal components. Established processes such as casting, plate rolling-and-welding, forging, drawing, and extrusion, have been used to fabricate structural and pressure-retaining materials used in the nuclear power industry for the past 60 years. However, issues of weldability, inspectability, and casting defects such as porosity, continue to challenge the manufacture of reactor vessels and internals, enhancing their susceptibility to degradation and failure. Reactor vessels and internals are subject to harsh service environments that combine high radiation fluence, high temperature, and mechanical stress, which accelerate material degradation. The most extreme degradation often occurs in weldments and poor-quality components that were inadequately inspected. Advanced reactor designs and life extensions to the existing fleet of light water reactors (LWRs) will further exacerbate materials degradation issues by increasing the duty on reactor internals. Thus, developing reliable manufacturing processes to ensure high-quality weldments and inspections can be performed, is of great importance to the continued safety and operation of nuclear power plants. Recently, alloys produced by powder metallurgy and hot isostatic pressing (PM-HIP) have successfully been developed and introduced for structural pressure-retaining applications in the electric power industry [1]. These PM-HIP components exhibit excellent structural uniformity, no chemical segregation, superior mechanical properties, and enhanced weldability. In addition, PM-HIP components are produced near-net shape, which offers the distinct advantages of minimizing machining and enhancing the ease of component inspectability. Components fabricated by PM-HIP are also lower-cost and higher quality than those fabricated by casting, owing to their reduced porosity and weight. Because of their exceptional properties, PM-HIP alloys have attracted the interest of the nuclear power industry as potential structural materials for LWRs, advanced light water reactors (ALWRs), small modular reactors (SMRs), and advanced (e.g. Generation IV) reactors. But little is known about the irradiation response of PM-HIP alloys, and even more critically, existing data do not elucidate the differences in irradiation response between PM-HIP and conventional alloys. This project seeks to understand these irradiation effects through a systematic neutron irradiation campaign and post-irradiation microstructural and mechanical assessments. The objective of this project is to assess the viability of using alloys manufactured by PMHIP for nuclear reactor internals, in order to enhance the quality, weldability, and inspectability of these components. Improving the manufacturing processes for reactor internals will have crosscutting impact across all DOE-NE programs. This project will compare the irradiation response of six PM-HIP and conventionally manufactured alloys commonly used in LWR internals, or which are candidates for ALWR and SMR internals, having relevance to all DOE-NE base programs. This project will also supplement ongoing DOE Nuclear Energy Enabling Technologies (DOE-NEET) research on Innovative Manufacturing Process for Nuclear Power Plant Components via Powder Metallurgy and Hot Isostatic Processing Methods (DE-NE000054). Several original equipment manufacturers (OEMs) are exploring PM-HIP techniques for reactor internals. Along with additional industry and university partners, they have provided input to the proposed workscope and will serve on the Industrial Advisory Board for this project. Furthermore, use of PM-HIP technology will help re-establish nuclear manufacturing in the United States. Book / Journal Publications "In situ tensile study of PM-HIP and cast 316L stainless steel and Inconel 625 alloys with high energy diffraction microscopy" Janelle Wharry, Donna Guillen, Elizabeth Getto, Darren Pagan, Materials Science & Engineering A 738 2018 380-388

"Comparative Thermal Aging Effects on PM-HIP and Forged Inconel 690" Keyou Mao, David Gandy, Janelle Wharry, JOM 70 2018 2218-2223 Link

"Thermal Aging and the Hall–Petch Relationship of PM-HIP and Wrought Alloy 625" Janelle Wharry, Keyou Mao, David Gandy, Elizabeth Getto, JOM 71 2019 2837 Link

"Comparison of ion irradiation effects in PM-HIP and forged alloy 625" Caleb Clement, Yangyang Zhao, Patrick Warren, Xiang Liu, Sichuang Xue, David Gandy, Janelle Wharry, Journal of Nuclear Materials 558 2022 Link

"Experiment design for the neutron irradiation of PM-HIP alloys for nuclear reactors" Donna Guillen, Janelle Wharry, Gregory Housley, Cody Hale, Jason Brookman, David Gandy, Nuclear Engineering and Design 402 2023 Link

Conference Publications "Neutron Irradiation of Nuclear Structural Materials Fabricated by Powder Metallurgy with Hot Isostatic Pressing" David Gandy, Donna Guillen, Janelle Wharry, 2017 ANS Annual Meeting [unknown]

Additional Info

Field	Value
PI	Janelle Wharry

Additional Info

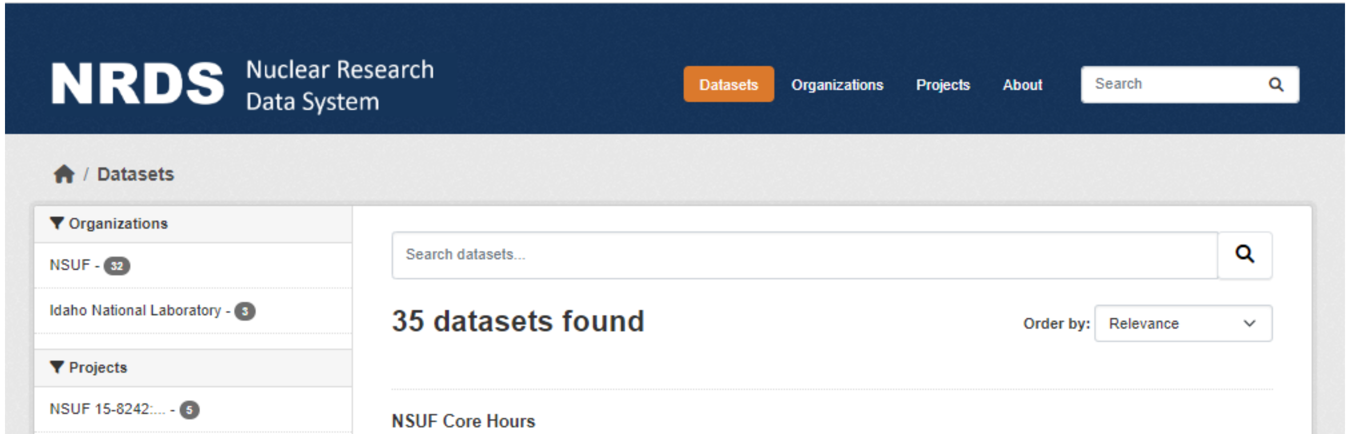
Field	Value
Author	Trishelle Copeland-Johnson
Last Updated	February 27, 2024, 2:04 PM (UTC-07:00)
Created	February 7, 2024, 10:31 AM (UTC-07:00)
OSTI	
DOI Link	https://doi.org/10.48806/2287679
Instrument	FEI G4 Helios Hydra Plasma-FIB
Publication	Copeland-Johnson TM, Murray DJ, Cao G and He L (2022) Assessing the interfacial corrosion mechanism of Inconel 617 in chloride molten salt corrosion using multi-modal advanced characterization techniques. Front. Nucl. Eng. 1:1049693. doi: 10.3389/fnuen.2022.1049693
Slice Offset	100 nm
Statement of Credit	"Focused ion beam tomography of Alloy 617 corroded in molten chloride salt" by Trishelle Copeland-Johnson and Daniel J. J. Murray is licensed under CC BY 4.0 for distribution.

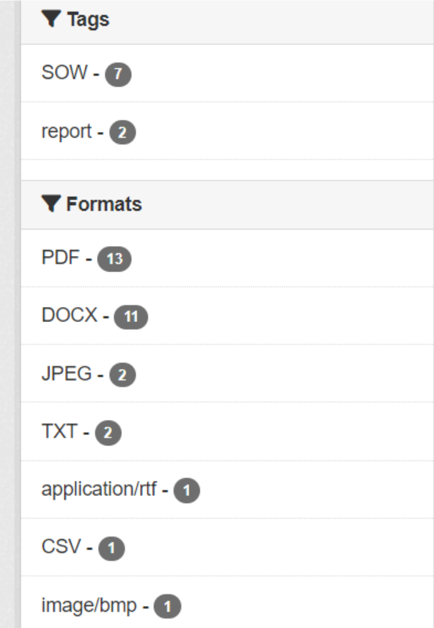
FpAIRe Data

- Findability
- Peekable
- Accessibility
- Interoperable
- Reusable
- Extensible

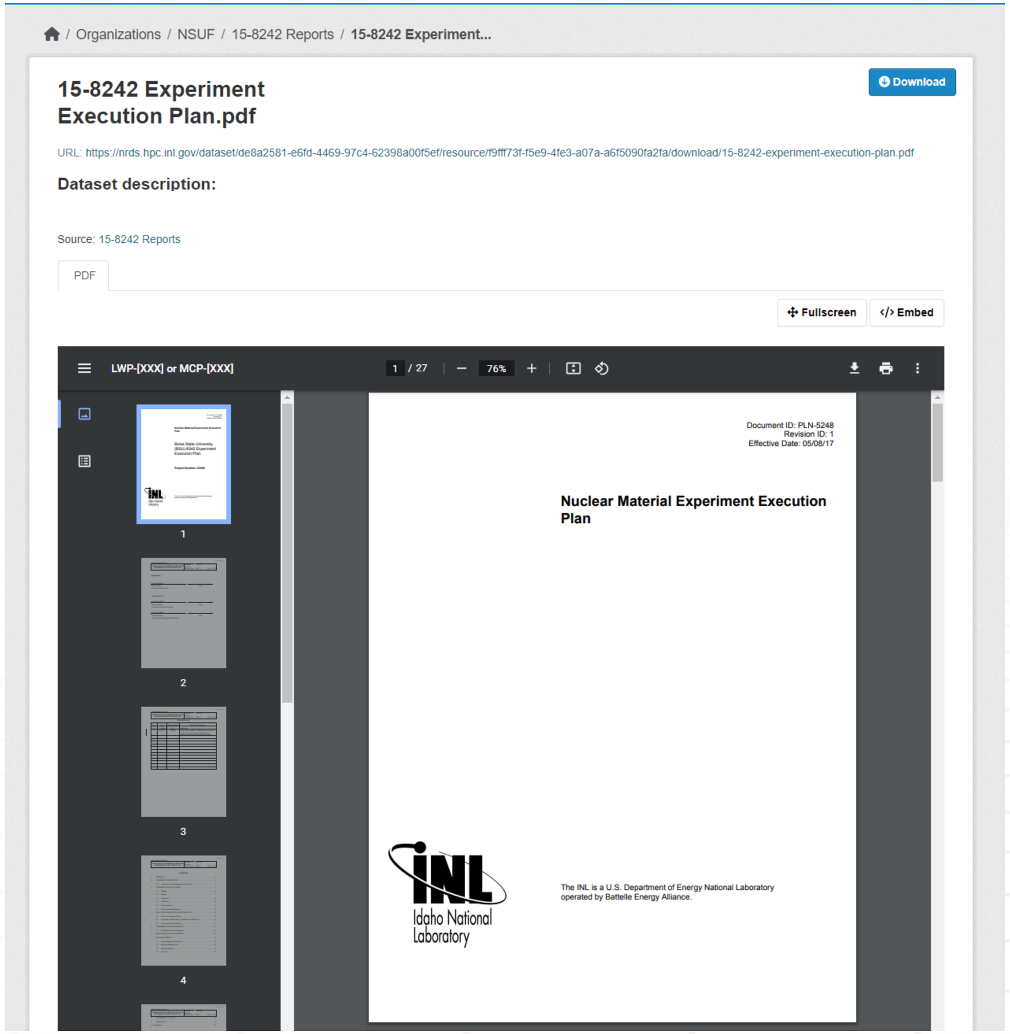
Findability

- Search features
- DOI Link
- Organized by projects
- Tags
- OSTI Link

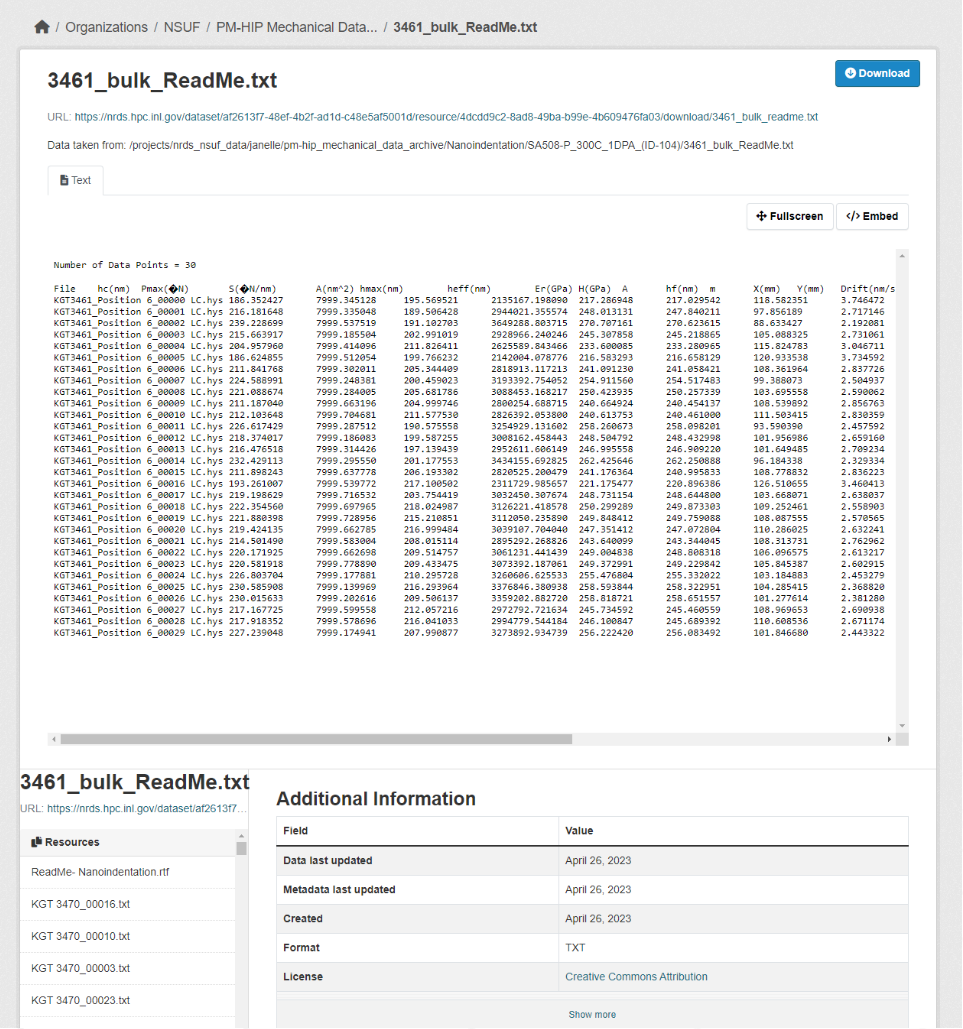




Peekable



Organizations / NSUF / 15-8242 Reports / 15-8242 Experiment...
15-8242 Experiment Execution Plan.pdf
Download
URL: https://nrds.hpc.inl.gov/dataset/de8a2581-e6fd-4469-97c4-62398a00f5ef/resource/f9fff73f-f5e9-4fe3-a07a-a6f5090fa2fa/download/15-8242-experiment-execution-plan.pdf
Dataset description:
Source: 15-8242 Reports
PDF
Fullscreen
Embed
LWP-[XXX] or MCP-[XXX]
1 / 27
76%
Document ID: PLN-5248
Revision ID: 1
Effective Date: 05/08/17
Nuclear Material Experiment Execution Plan
INL Idaho National Laboratory
The INL is a U.S. Department of Energy National Laboratory operated by Battelle Energy Alliance.



Organizations / NSUF / PM-HIP Mechanical Data... / 3461_bulk_ReadMe.txt
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Value
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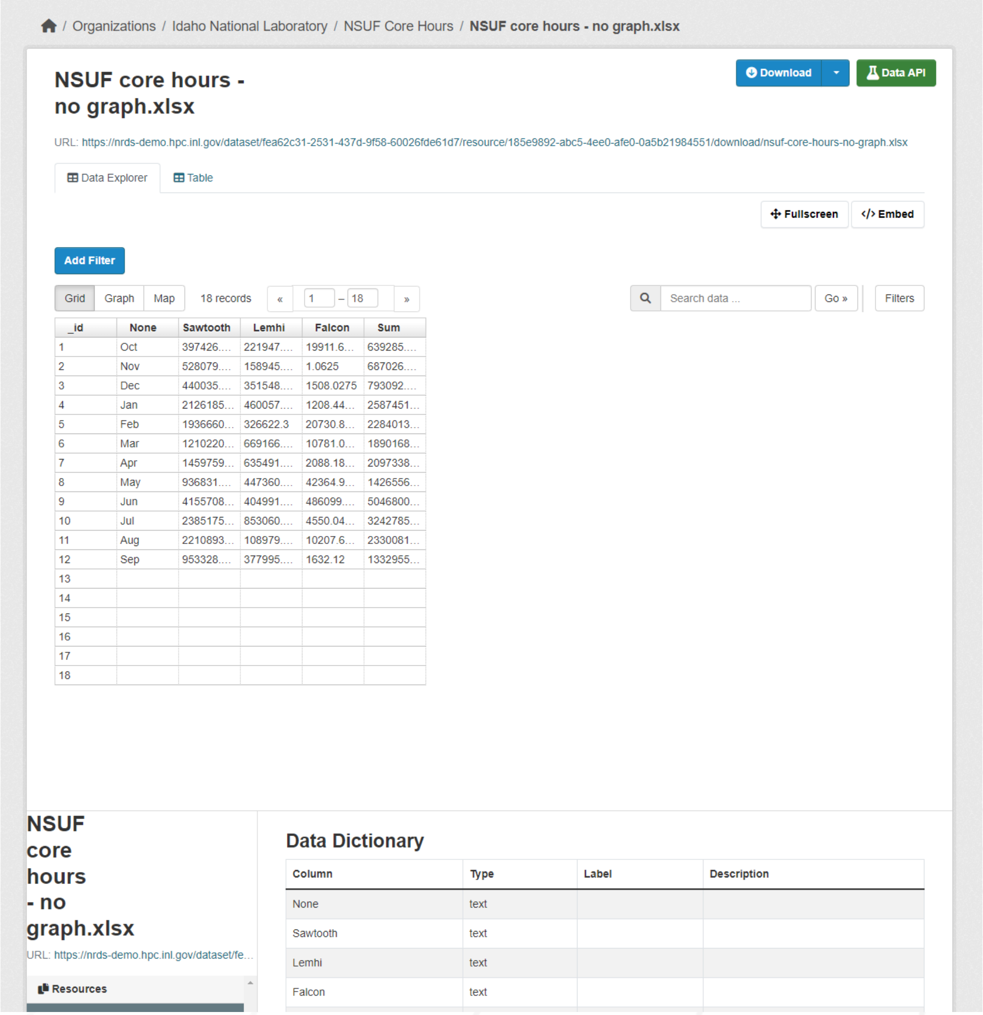
Peekable


Organizations / Idaho National Laboratory / NSUF Core Hours / NSUF core hours - no graph.xlsx
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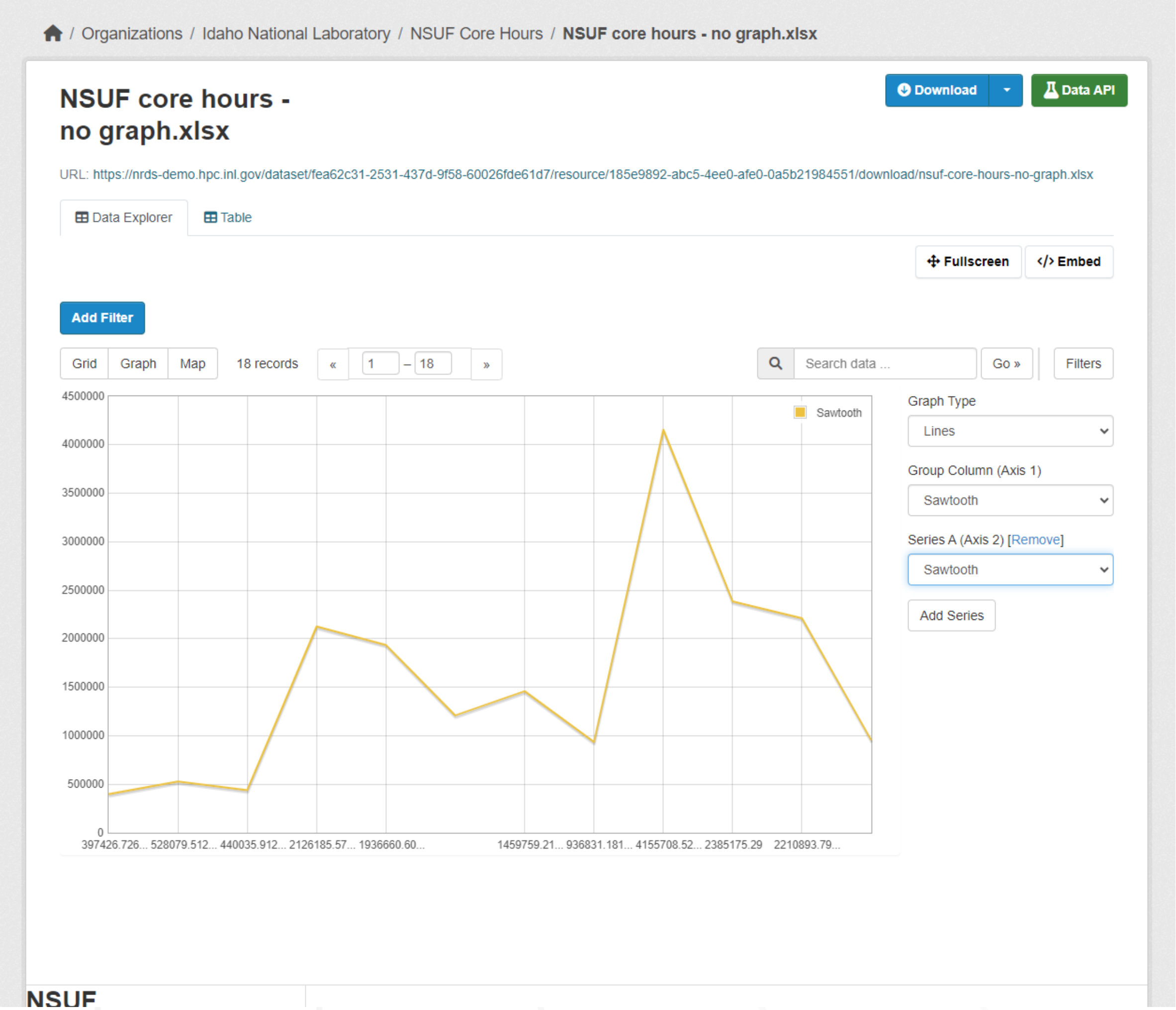
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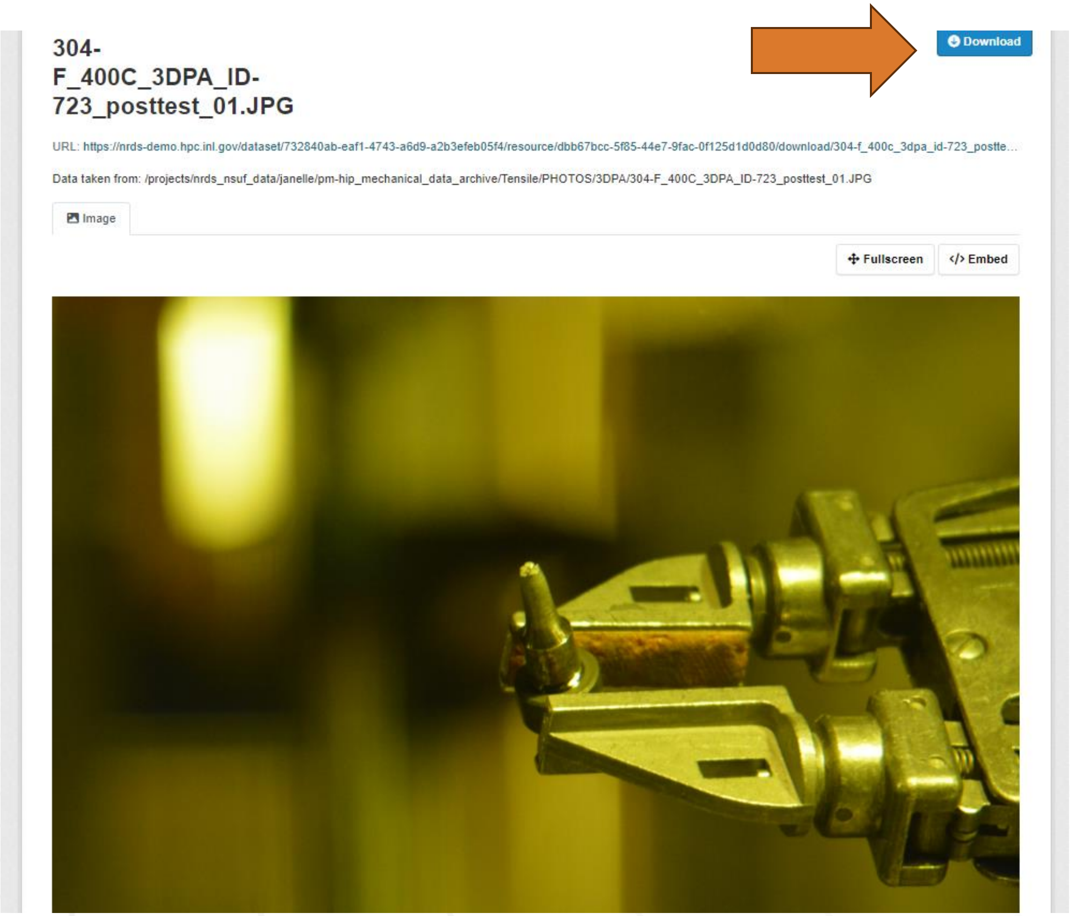
Series A (Axis 2) [Remove]
Sawtooth
Add Series
NSUF

Accessibility

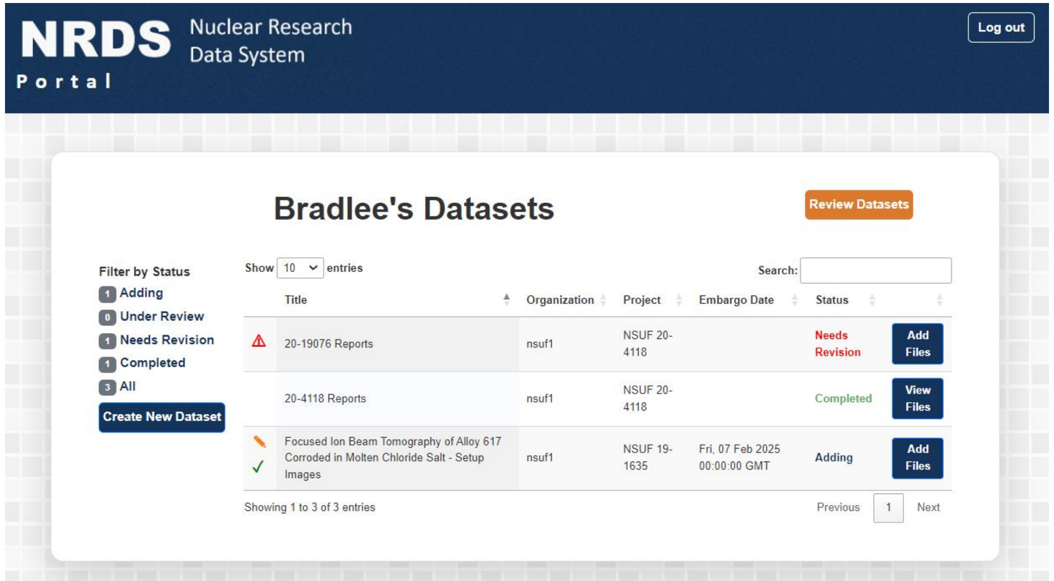
- Anyone can view data
- No password required
- DOIs created upon upload
- Creative Commons Attribution
  - Open sourced, publicly available data

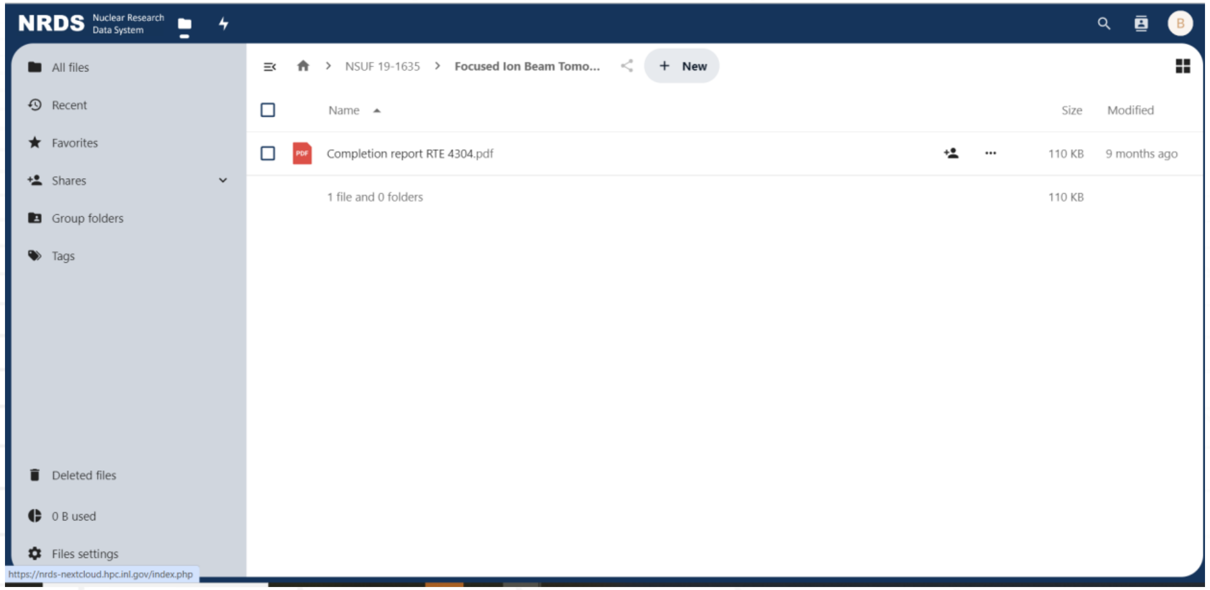


Enhancing Interoperability NRDS Portal

Place for PIs and researchers to upload and collaborate on datasets within their project before having them become public on NRDS

- Embargos will be enforced
- DOIs will be automatically created for each dataset
- Allows drag and drop for files
- The project PI and NSUF review team will both have to either approve or reject dataset before it is submitted to NRDS



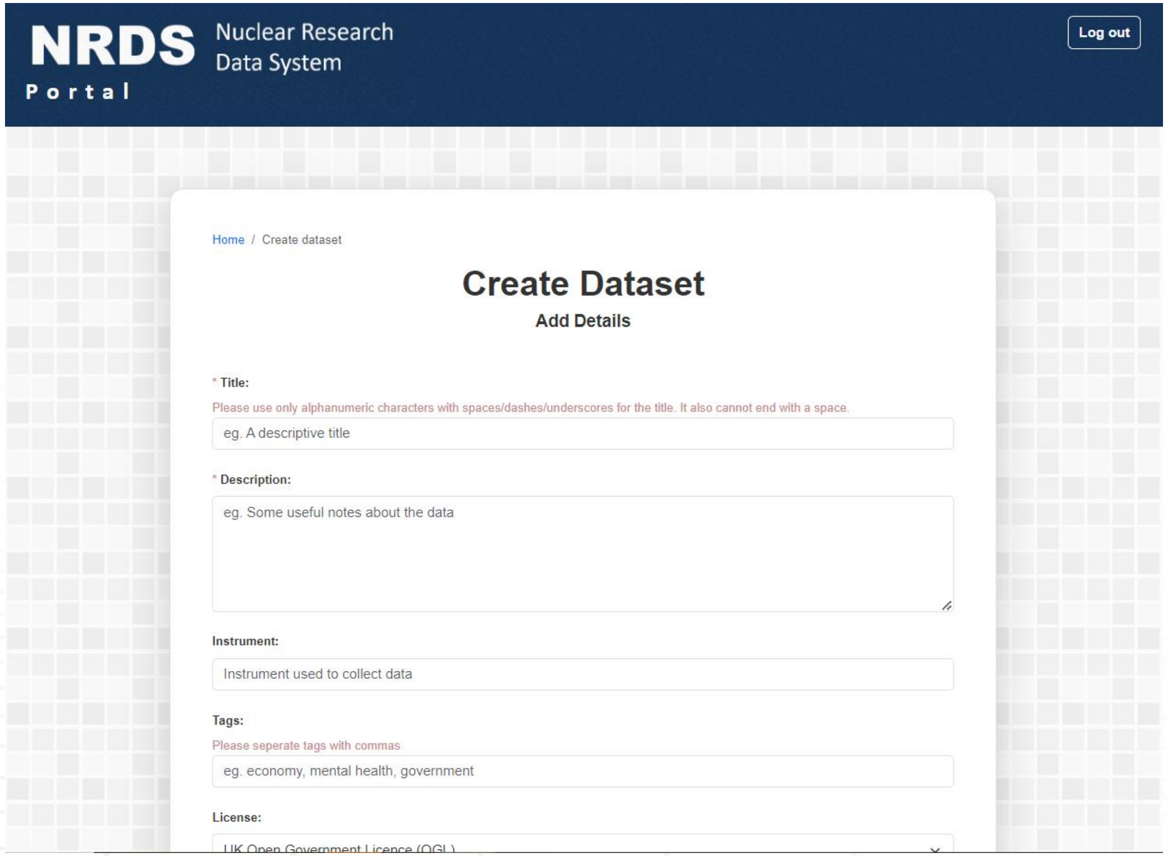


- Timeline – **Public by August 2024**

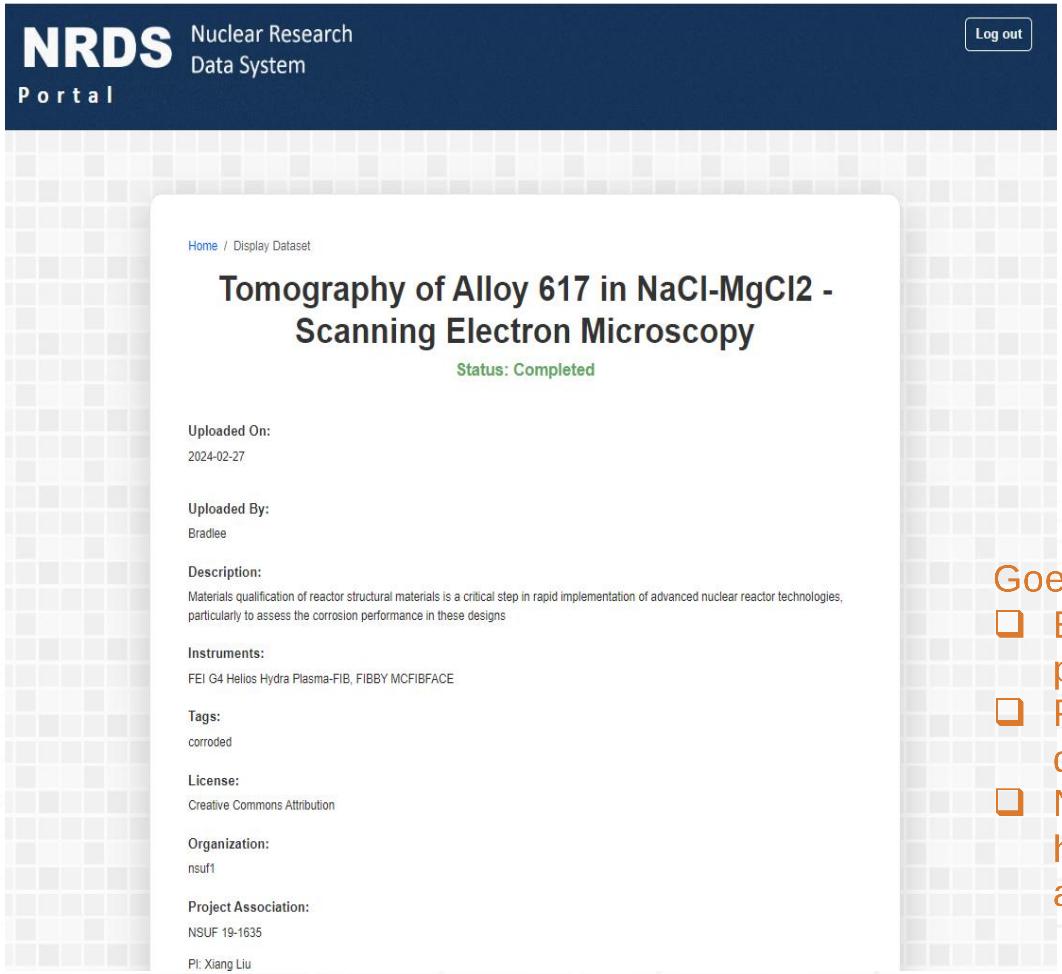
Dataset Fields

Fields for uploading a dataset:

Field name	Explanation	Required?
Title	A descriptive title that the dataset will be released as on the main NRDS website.	Yes
Description	Some useful information about the data, similar to a project abstract.	Yes
Instruments	The device(s) used to collect/generate the data, including any model numbers.	No
Tags	Keywords that describe the dataset and will be able to be used as filters.	No
License	The copyright license this dataset will be released under.	Yes
Project Association	The project that this data was collected as part of and funded by.	Yes
Embargo Expiration	The date the data associated with this dataset will be released for the public.	No
Author(s)	The author(s) of the dataset to be listed on the main NRDS website.	No
Statement of Credit	The statement that others will use to give you credit for/cite your work.	Yes
Dataset DOI	If no DOI is entered, NRDS will automatically generate one and email it to you.	No

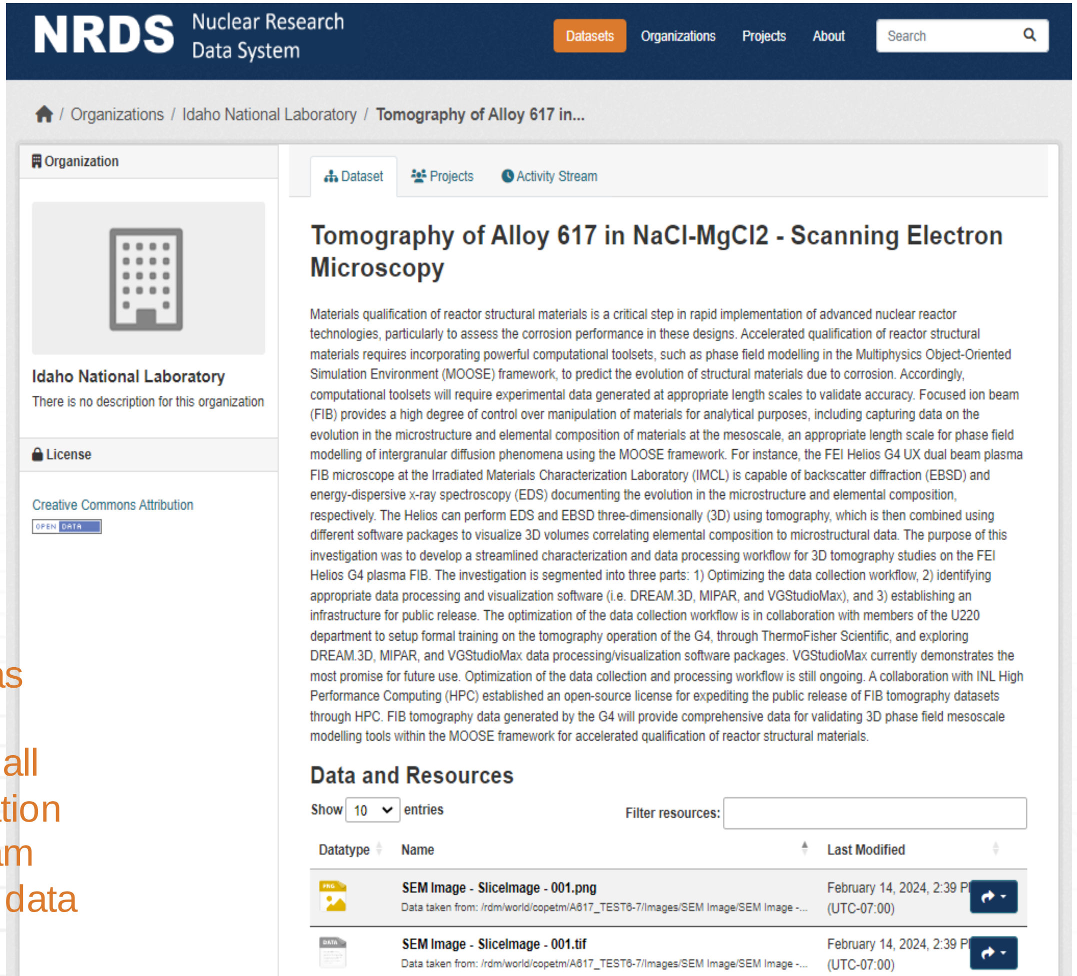


NRDS Portal to NRDS



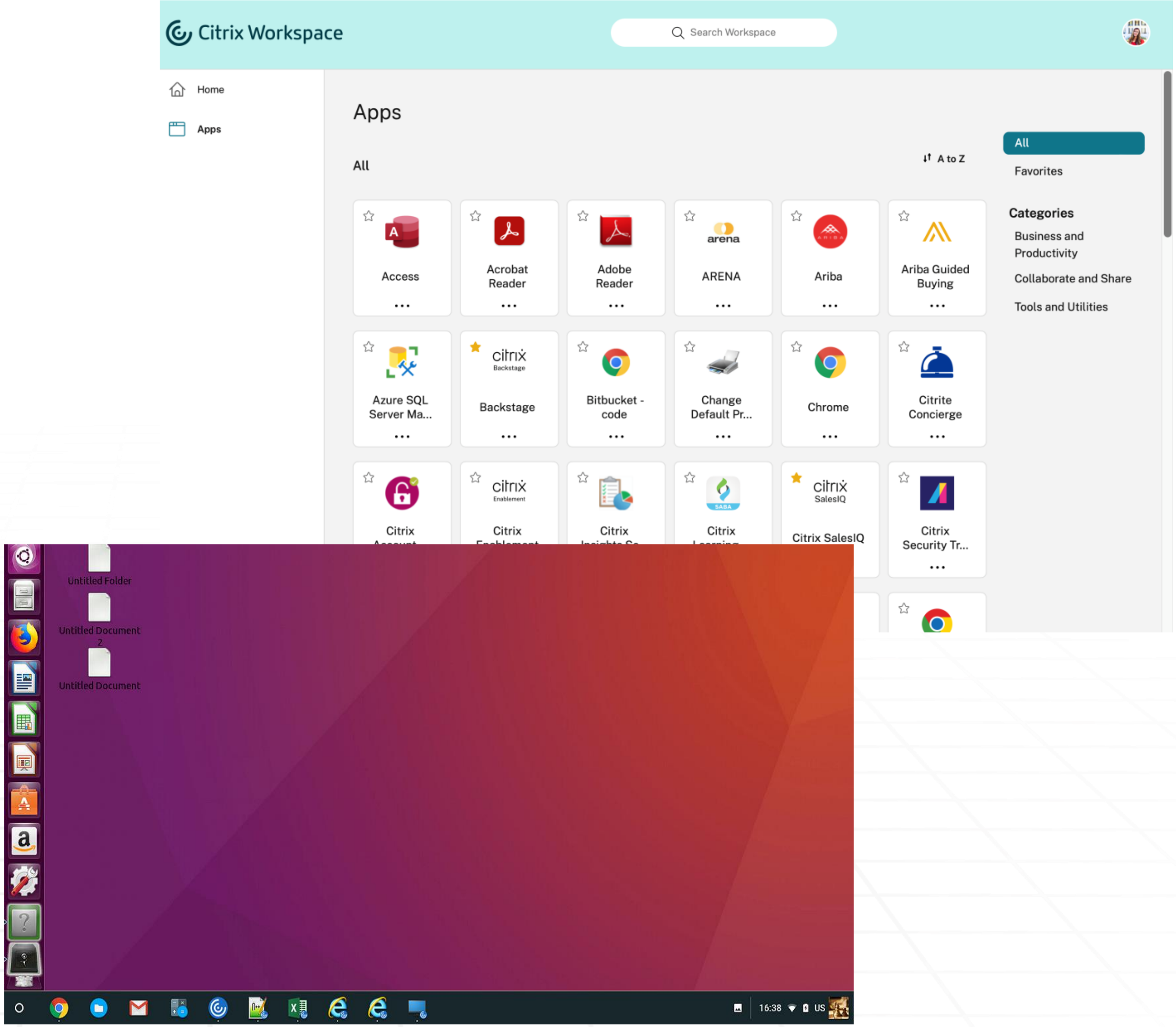
Goes to NRDS after:

- ❑ Embargo date has past
- ❑ PI has approved all data and information
- ❑ NSUF review team has approved all data and information

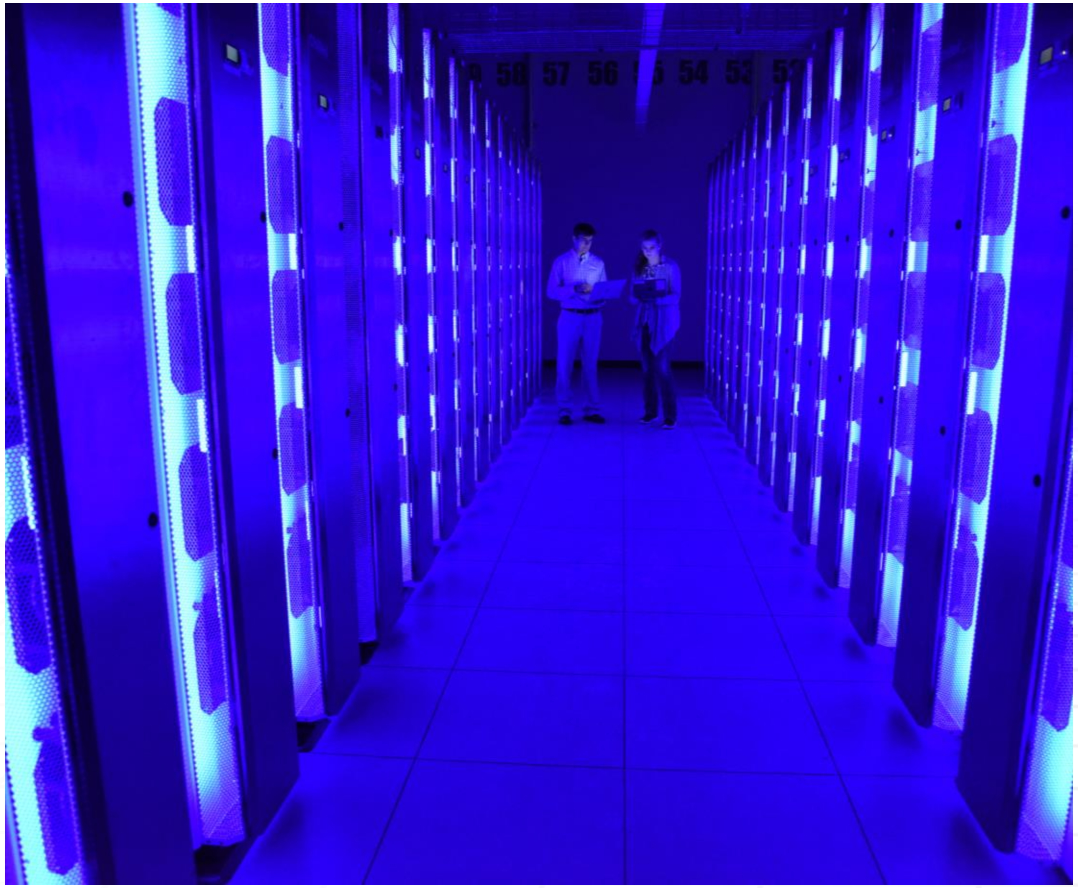


NRDS Portal Hypervisor

- Will allow HPC access via Citrix Hypervisor which will include:
  - Virtual Windows desktops
  - Direct access to GPUs
  - Access to run software such as Avizo and VGStudioMax
- All uploaded data by the user or the project the user is in will be available for use for that user
- Only users within the specific project can view or use the data for the project

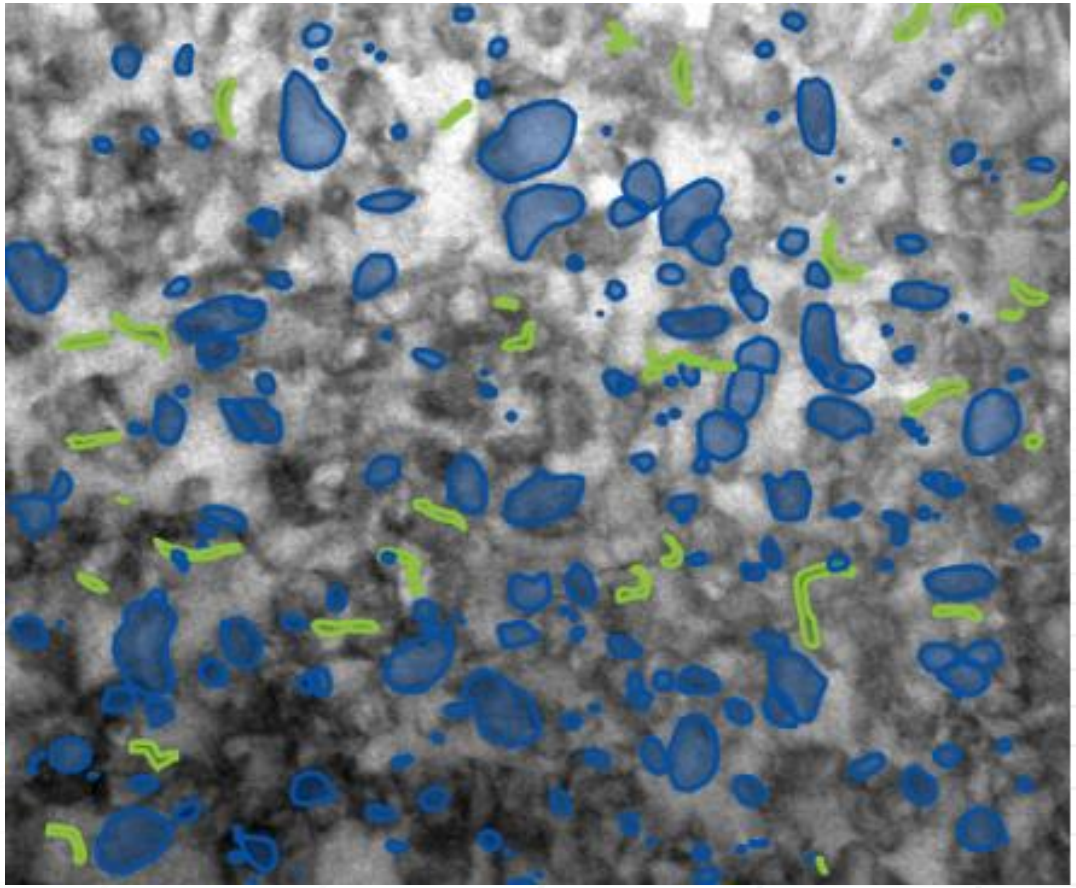


Reusable



- NRDS Storage will keep the data
  - 1.2 PB initially
- Stored in a non-proprietary format

Extensible



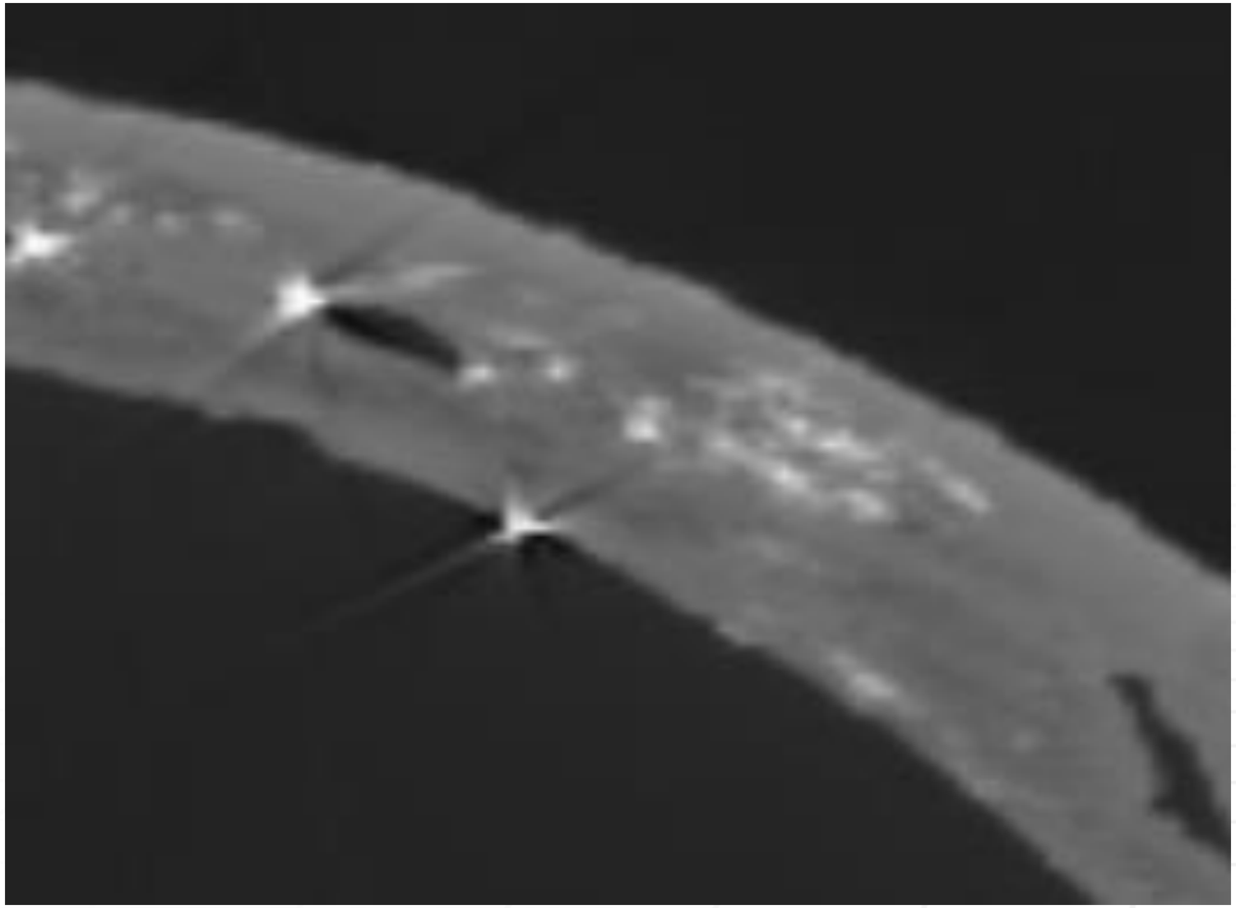
- Annotation will give data new life
  - AI Analysis
  - New discoveries

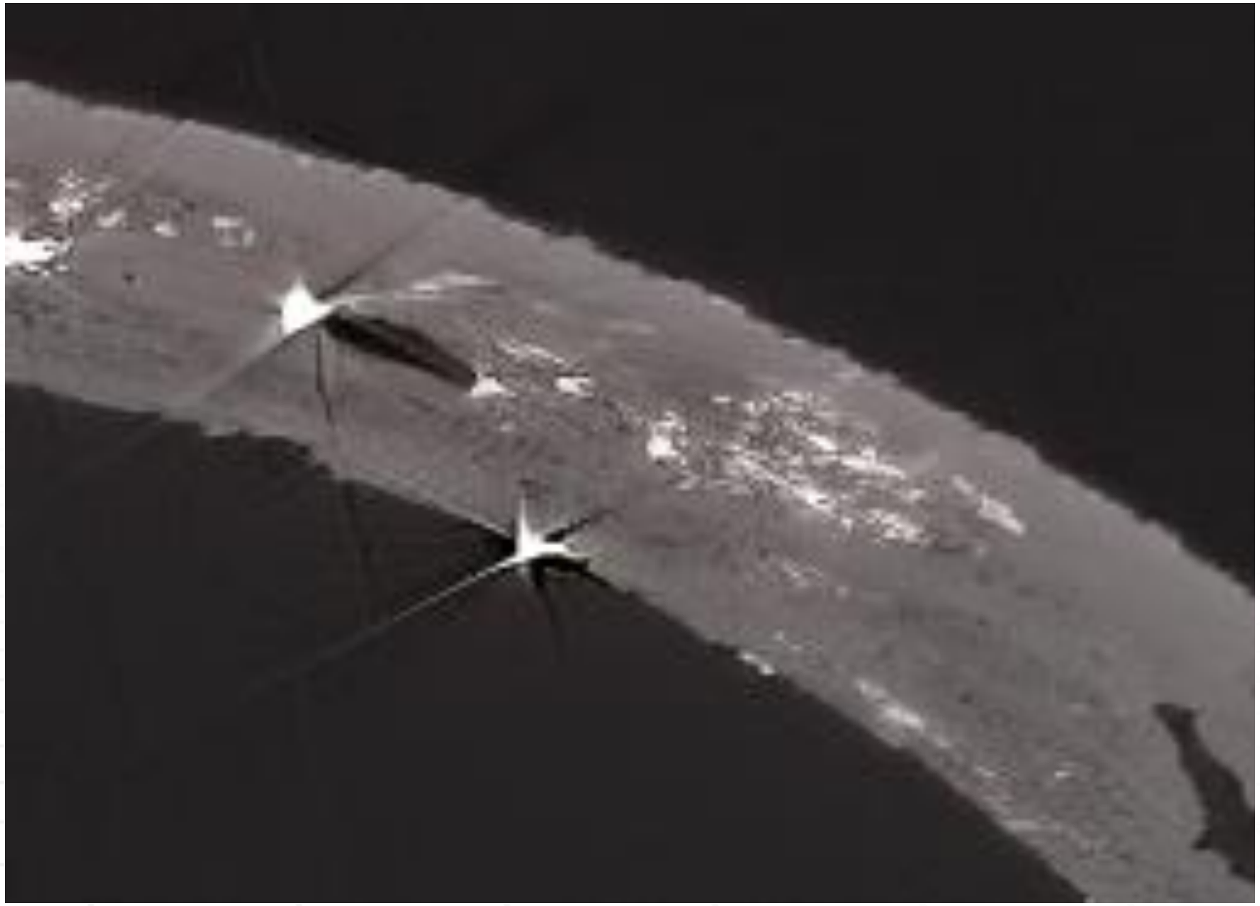
AI Analysis

- **Currently Available**
  - Super Resolution
  - Activity Detection
- **Coming Soon**
  - Anomaly Detection
  - Object Detection
  - Stitching

Super Resolution

Super Resolution





Activity Detection

Activity Detection

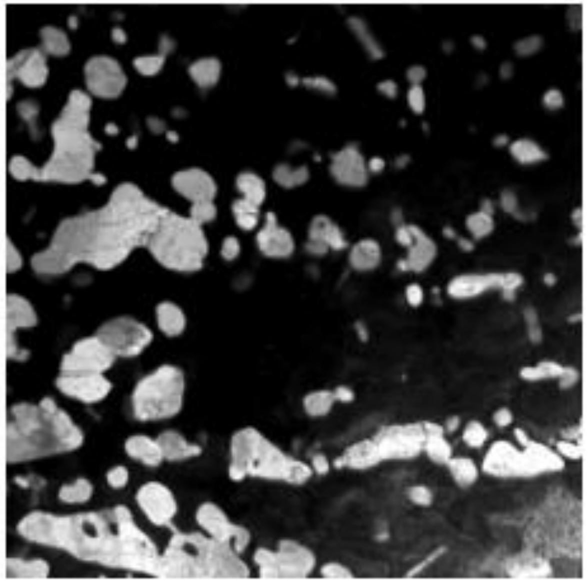
Activity is marked based on the previous 25 frames of a video

Images will be deleted after one day of generation. Please make sure to download the image or else the image will have to be regenerated

Detect

Compare Images

Original



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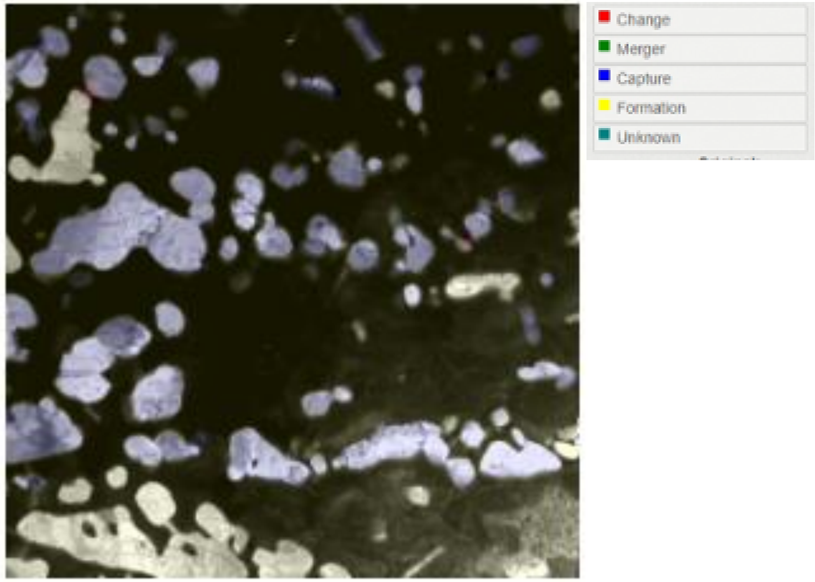

NRDS

- Site that is a public science data gateway that will allow public data to be downloaded, previewed, or enhanced through AI
- FpAIRe data
  - Proprietary data
  - Embargo dates
- Data collection efforts are on going

https://nrds.inl.gov/

Questions?

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