



GAS-COOLED REACTOR

ADVANCED REACTOR TECHNOLOGIES PROGRAM



NDMAS

Nuclear Data Management and Analysis System

July 16, 2024

NDMAS Portal Updates

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DOE ART Gas-Cooled Reactor (GCR) Review Meeting

Hybrid Meeting at INL

July 16–18, 2024

Overview of Current ART-GCR Data

- Fuel Fabrication
- Irradiation Monitoring (Fuel & Graphite – near real-time for HDG-1)
- Post-Irradiation Examination (Fuel & Graphite)
- Graphite Characterization (Baseline and Irradiated)
- High Temperature Metals Mechanical Tests
- Methods Validation Data
 - Japan Atomic Energy Agency's High Temperature Test Reactor (HTTR)
 - Argonne National Laboratory's Natural convection Shutdown heat removal Test Facility (NSTF)
 - Oregon State University's High Temperature Test Facility (HTTF)
- Additional related data
 - Advanced Test Reactor operations (near real-time)



Added AGR Fuel Data

- AGR-3/4 particle data (ongoing)
 - Compact and particle inventory data from radial DLBL
 - Post-irradiation (8 compacts)
 - Post-safety test (2 compacts)
 - Post-safety test and post-NRAD reirradiation (3 compacts)
- Furnace temperature history for safety tests (some AGR-1 and AGR-2)
 - AGR-1 (3 INL compacts)
 - AGR-2 (all 15 compacts)
- AGR Fuel Summary page
 - Data downloads for all completed AGR irradiations (1, 2, 3/4, 5/6/7)
 - Links to interactive data portals (SAS VA) for Irradiation and PIE data
- Notes to augment data interpretation

The screenshot displays the NDMAS SharePoint interface. The main page is titled "AGR Fuel Summary" and provides an overview of the structural isotropic (TRISO) fuel development and qualification R&D. It lists activities such as Fabrication, Irradiation, and Post-irradiation Examination and Safety Testing. Below this, there is a section for "Selected Data Files" with links to experiments AGR-1, AGR-2, AGR-3/4, and AGR-5/6/7. A "Supporting Information" section mentions publicly available U.S. Department of Energy records. A link to the "AGR library" is also present.

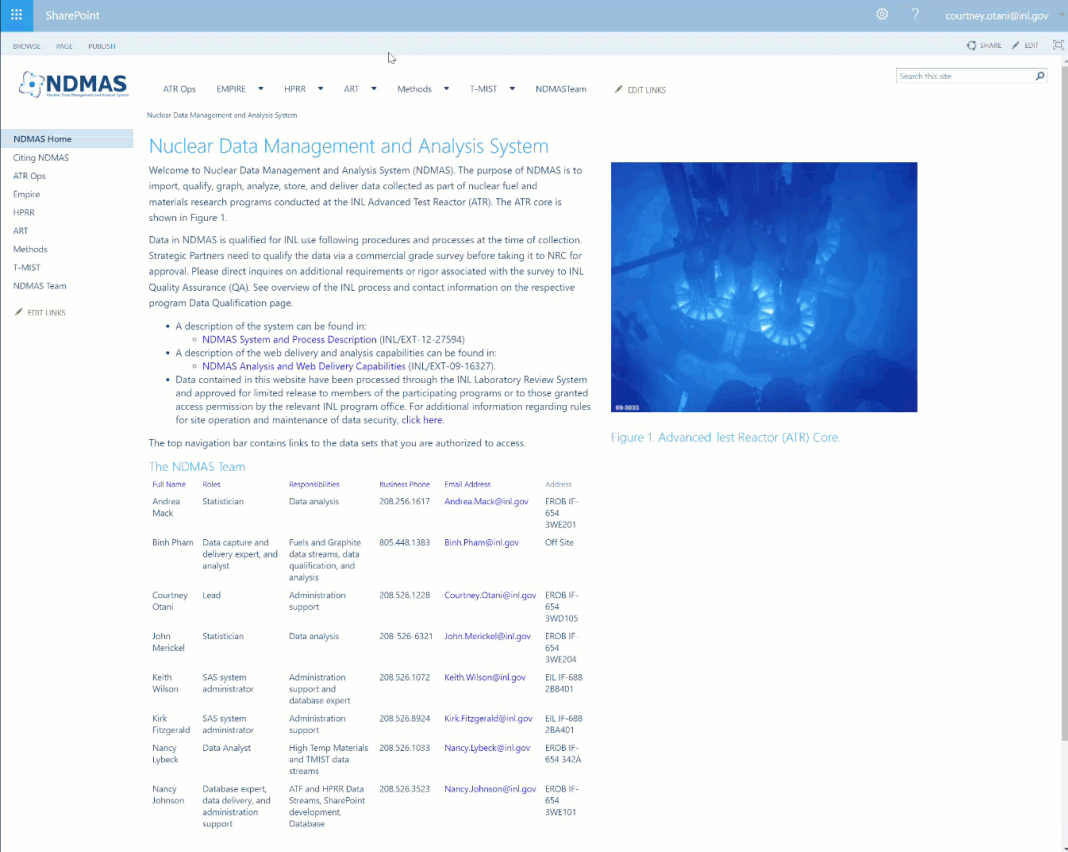
Two interactive data portals are shown below the main page:

- AGR Irradiation Monitoring Data:** This portal displays a grid of line graphs for various capsules (01-05) and experiments (162B, 163A, 164A, 164B, 165A, 166A, 166B, 167A, 168A). The graphs show parameters like Gas Flows, TCs, TC Residuals, Krypton/Rb, Xenon/Rb, Fuel Temperature, and Burnup over time.
- AGR Post-Irradiation Data:** This portal shows data for experiments AGR-1 and AGR-2. It includes a "Note" stating that furnace temperature history data is available for all 15 AGR-2 compacts and three AGR-1 compacts. The data is presented as a line graph for "Furnace Temperature, C" and "TC1 / TC2" for compact 4-3-3.



Added Other GCR and Related Data

- AGC
 - AGC-3 Exhaust Sweep Gas Cylinder Analysis
 - AGC-3 Physics Calculations
 - AGC-4 Exhaust Sweep Gas Cylinder Analysis
 - HDG-1 Irradiation Monitoring (constant updating)
 - Baseline Graphite: characterization data for Billet 2114-A20568 and Brazilian test for Billet NBG-18-635-14
 - Updated Publication categorized library list in SharePoint pages
 - ndmas.inl.gov (public)
 - ndmashome.inl.gov (access controlled)
- ATR operational data (constant updating)
- Interactive displays (Highcharts and VA)



The screenshot displays the SharePoint interface for the Nuclear Data Management and Analysis System (NDMAS). The page title is "Nuclear Data Management and Analysis System" and the URL is "ndmas.inl.gov". The main content area includes a welcome message, a description of the system's purpose, and a list of links to various data sets and reports. A table titled "The NDMAS Team" lists the names, roles, responsibilities, business phone numbers, email addresses, and addresses of the team members.

Full Name	Roles	Responsibilities	Business Phone	Email Address	Address
Andrea Mack	Statistician	Data analysis	208.256.1617	Andrea.Mack@inl.gov	EROB IF-654 3WE201
Binh Pham	Data capture and delivery expert, and analyst	Fuels and Graphite data streams, data qualification, and analysis	805.448.1383	Binh.Pham@inl.gov	Off Site
Courtney Otani	Lead	Administration support	208.526.1228	Courtney.Otani@inl.gov	EROB IF-654 3WD105
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Nancy Lybeck	Data Analyst	High Temp Materials and T-MST data streams	208.526.1039	Nancy.Lybeck@inl.gov	EROB IF-654 342A
Nancy Johnson	Database expert, data delivery, and administration support	ATR and HPRR Data Streams, SharePoint development, Database	208.526.3523	Nancy.Johnson@inl.gov	EROB IF-654 3WE101



Updated High Temperature Metals

- Fully back online
- Steam Generator and Intermediate Heat Exchange
- Reactor Pressure Vessel
- Dropdown options for streamlined viewing of data

SharePoint

NDMAS Home

ART

Fuels

Graphite

HTM Home

HTM Data Qualification

Steam Generator & Intermediate Heat Exchange

Reactor Pressure Vessel

ATR Ops

EMPIRE

HPRR

ART

Methods

T-MST

NDMASteam

EDIT LINKS

Search this site

Characterization of Alloy 617 (IHx) and Alloy 800H (SG)

Today's high temperature alloys and associated ASME Codes for reactor applications are approved for temperatures up to 750°C. However, some primary system components, such as the intermediate heat exchanger for the Very High Temperature Reactor (VHTR), will require the use of materials that can withstand higher temperatures. There are specific weaknesses in the understanding of material properties at these high temperatures. A large matrix of testing to support the design and licensing of a VHTR has been developed (Wright, 2008; PLN 2804, available for download inside the INEL firewall). Tests include the measurement of mechanical, physical, and corrosion characteristics of Alloys 617 and 800H at high temperatures. Data from the tests was collected under NQA-1 standards and will be used to extend ASME Codes for reactor operations to the temperatures needed to license the VHTR.

Categories of testing are described below. Links to results, grouped by type of testing, are available to the right.

Data qualification status is available here, all data are considered preliminary prior to qualification.

Creep Tests

Interrupted Creep and Creep Rupture testing utilized Alloy 617 tensile specimens. The specimens were tested in air between 750° and 1000°C, with applied stress ranges from 11 to 388 MPa. Product form will be plate from a single heat (xyz-CF).

For the interrupted creep tests, microstructural evaluations (TEM, SEM, etc.) are performed on creep specimens at certain strain levels or periods along the creep curves. The test specimens should be cooled under load before their removal from the test frame to preserve the existing microstructure. The objective is to identify different microstructural processes such as dislocation interactions, subgrain formations, dislocation multiplication, dislocation-carbide interactions, diffusional creep mechanism, grain boundary cavitation, cracking, etc., at different locations along a creep curve. This will differentiate the contributions of deformation and damage in the part of the creep curve usually considered to be in the tertiary creep regime.

Cyclic Tests

Cyclic tests for Alloy 617 include both fatigue and creep-fatigue tests. Creep-fatigue is the most life-limiting structural failure mode for the elevated temperature IHx components. The purpose of cyclic testing includes supporting design curves for the ASME code case, determining the creep-fatigue interaction diagram, and determining environmental effects.

Tensile Tests

Time-independent design allowable stress limits are used to guard against the tensile failure mode owing to short duration loading at temperature, for example, during an earthquake. In support of the determination of time-independent design allowable stresses, S_{10} at elevated temperatures for Alloys 617 and 800H, tensile testing was performed in air at multiple temperatures. Ultimate tensile strength, yield strength, reduction of area, and elongation were tabulated for each test. The development of a code case for a new material requires these values at 50°C intervals, from room temperature to 50°C above the maximum intended use temperature.

Charpy Tests

Charpy impact testing is used to measure the amount of energy absorbed by a material during fracture. A notched test specimen is held securely on each end. A hammer on a pendulum arm strikes the specimen opposite the notch. The energy absorbed by the specimen is determined by measuring the decrease in motion of the pendulum arm. Charpy tests are frequently performed on identical specimens at different temperatures, and the impact energy is plotted as a function of temperature.

SG&IHx Test Results

Name

- Test : Charpy (1)
- Charpy Tests
- Test : Creep (3)
- Creep Rupture Tests
- Interrupted Creep Tests
- Welded Creep Tests
- Test : Cyclic (6)
- Aging and Environmental Creep-Fatigue Tests
- Alternate Hold Cyclic Tests
- Baseline Creep-Fatigue Tests
- Baseline Fatigue Tests
- Ratcheting Tests
- Welded Creep-Fatigue Tests
- Test : Tensile (4)
- Baseline Tensile Tests
- Strain Rate Sensitivity Tests
- Stress Dip Tests
- Thermally Aged Tensile Tests

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Security/Privacy
NQA-1 Compliance

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Ongoing and Upcoming Work

- AGR
 - Continued work on AGR 3/4 radial DLBL data and other PIE data
- AGC
 - More baseline data coming
 - Oxidation data coming
- Gen IV Materials Handbook
 - Metals, graphite, ceramics, and composites data from GIF Materials project group



Users Guide

- Clarifies instruction and content on access and navigation for all aspects of the ART-GCR programs, which include data from
 - Advanced Gas Reactor (AGR) fabrication, irradiation experiments, and post-irradiation examination
 - Advanced Graphite Creep (AGC) and High-dose Graphite Creep (HDG) irradiation experiments, graphite material characterization
 - High Temperature Metals (HTM) characterization
- Other information
 - Acronyms
 - Index to all webpages: organized by general topic
- <https://ndmashome.inl.gov/art/user-guide>

The screenshot shows the SharePoint interface for the NDMAS ART User Guide. The page title is "ART User Guide" and the breadcrumb trail is "Nuclear Data Management and Analysis System > High Temperature Reactor > ART User Guide". The page content includes an introduction to NDMAS, a list of data activities (Database Management, Data Capture, Data Qualification, Data Analysis), and data delivery methods (SharePoint Webpages, SAS Visual Analytics Reports, Customized Format). A flow chart titled "NDMAS roles" is displayed, showing the relationship between various roles and their associated activities.

NDMAS roles flow chart:

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graph TD; NDMAS_roles[NDMAS roles] --> Administration_support[Administration support]; NDMAS_roles --> Data_activities[Data activities]; NDMAS_roles --> Data_delivery[Data delivery]; NDMAS_roles --> ART_programs[ART programs]; Administration_support --> Access_control[Access control]; Administration_support --> Software_support[Software support]; Administration_support --> Change_control[Change control]; Administration_support --> Troubleshooting[Troubleshooting]; Data_activities --> Database_management[Database management]; Data_activities --> Data_capture[Data capture]; Data_activities --> Data_qualification[Data qualification]; Data_activities --> Data_analysis[Data analysis]; Data_delivery --> SharePoint_webpages[SharePoint webpages]; Data_delivery --> Visual_analytics_reports[Visual Analytics reports]; Data_delivery --> Customized_format[Customized format]; ART_programs --> Fuels[Fuels]; ART_programs --> Graphite[Graphite]; ART_programs --> High_temperature_metals[High Temperature Metals (HTM)];
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Figure 1. NDMAS roles flow chart.





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TECHNOLOGIES PROGRAM**

Interested in gaining access to NDMAS?

Please email ndmas-webadmin@inl.gov. For other questions, email Courtney Otani.

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NDMAS
Nuclear Data Management and Analysis System



U. S. DEPARTMENT OF
ENERGY