Industry-Informed Physics-Based Monitoring for Asset Management and Maintenance Optimization

Final CRADA Report

Nuclear Science and Engineering Division
About Argonne National Laboratory
Argonne is a U.S. Department of Energy laboratory managed by UChicago Argonne, LLC under contract DE-AC02-06CH11357. The Laboratory’s main facility is outside Chicago, at 9700 South Cass Avenue, Lemont, Illinois 60439. For information about Argonne and its pioneering science and technology programs, see www.anl.gov.

DOCUMENT AVAILABILITY


Reports not in digital format may be purchased by the public from the National Technical Information Service (NTIS):
U.S. Department of Commerce
National Technical Information Service
5301 Shawnee Rd
Alexandria, VA 22312
www.ntis.gov
Phone: (800) 553-NTIS (6847) or (703) 605-6000
Fax: (703) 605-6900
Email: orders@ntis.gov

Reports not in digital format are available to DOE and DOE contractors from the Office of Scientific and Technical Information (OSTI):
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831-0062
www.osti.gov
Phone: (865) 576-8401
Fax: (865) 576-5728
Email: reports@osti.gov

Disclaimer
This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor UChicago Argonne, LLC, nor any of their employees or officers, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of document authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof, Argonne National Laboratory, or UChicago Argonne, LLC.
Industry-Informed Physics-Based Monitoring for Asset Management and Maintenance Optimization

Final CRADA Report

prepared by
T. Nguyen, R. Ponciroli, and R. Vilim
Nuclear Science and Engineering
Division, Argonne National Laboratory

Participants: LPI, Inc.

January 31, 2022
This page intentionally left blank
CRADA Number: 2019-19191
CRADA Title: Industry-Informed Physics-Based Monitoring for Asset Management and Maintenance Optimization
CRADA Start Date 8/1/2019 – End Date 9/30/2021

DOE Program or Other Government Support
Program office: OTT
Program manager name: David Yarwood
Program manager phone or email: not available

Participant(s)
Participant 1 name: Thomas Esselman, LPI
Complete address: LPI, Amsebury MA

Participant 2 name: Click or tap here to enter text.
Complete address: Click or tap here to enter text.

Participant 3 name: Click or tap here to enter text.
Complete address: Click or tap here to enter text.

Argonne National Laboratory
Argonne PI(s): Click or tap here to enter text.

Funding Table
To add rows, right-click in bottom row and select “Insert” “rows above”.

<table>
<thead>
<tr>
<th></th>
<th>Planned Funding</th>
<th>Actual Funding</th>
<th>In-Kind</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government</td>
<td>$500K</td>
<td>$500K</td>
<td></td>
</tr>
<tr>
<td>LPI</td>
<td>$500K</td>
<td>$</td>
<td>$500K</td>
</tr>
<tr>
<td>Enter Participant 2 here</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Enter Participant 3 here</td>
<td>$</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>Total</td>
<td>$1000K</td>
<td>$500K</td>
<td>$500K</td>
</tr>
</tbody>
</table>

Nature of Work
Describe the research (summary of Scope of Work and principal objectives of the CRADA):
The purpose of the proposed work was to address issues expected to be encountered in commercial applications of the PRO-AID physics-based monitoring capability to minimize operations and maintenance (O&M) costs. O&M costs represent the largest fixed cost item for existing commercial reactors and new reactor designs.

DOE mission area(s):
Energy and Environmental Science and Technology
Choose an item.
Choose an item.
Conclusions drawn from this CRADA; include any major accomplishments:
The performance of the methods developed in this project for application to a nuclear power plant feedwater pump system, which includes a pump, a motor, and bearings and shaft were evaluated. Physics-based models were constructed to monitor the performance of the system components. Plant data were used for the calibration of the models and subsequently in the diagnosis of abnormal events. We considered two real-time events representing scenarios of a pump fault and component performance degradation. The two events were correctly diagnosed, and the results demonstrated the high detection sensitivity of the physics-based models. Various sensor fault scenarios were simulated to show the capability of the approach to detect and uniquely identify sensor faults. Results for a scenario in which the plant operated in flexible power mode also showed that the diagnostic approach is insensitive to changes of operating conditions, which is one of the advantages of the model-based approach using physics-based models over purely data-driven approach.

Technology Transfer-Intellectual Property
Argonne National Laboratory background IP:
Click or tap here to enter text.

Participant(s) background IP:
Click or tap here to enter text.

Identify any new Subject Inventions as a result of this CRADA:

Summary of technology transfer benefits to industry and, if applicable, path forward/anticipated next steps towards commercialization:
Currently meeting with venture capital firm with potential interest in funding a startup.

Other information/results (papers, inventions, software, etc.):
This page intentionally left blank