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Ontology for the Design of Innovative Nuclear Technologie

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IDL

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TOTAL APPROVED AMOUNT:
$129,500 over 1 year

PROJECT NUMBER:
19A42-024

PRINCIPAL INVESTIGATOR:
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A new nuclear ontology is the first fully open-source common ontology for nuclear design with a scientific basic formal ontology core that allows for standardization of a data model for reactor design with verification and validation of the data model's functional properties facilitated through modeling and simulation.

The construction, aerospace, and automotive industries have achieved considerable cost and schedule savings by utilizing virtual design. This approach is not shared by the nuclear industry where the current ecosystem of tools and solutions for nuclear technology development implement proprietary data ontologies to capture design information. The storage of critical design information is in disparate, proprietary systems which reduces the ability to connect information. To create a generic, common framework to enable digital engineering programs for reactor design, this project developed a formal representation of information called a data ontology. A usable ontology needed to be compatible with other domain ontologies, right sized to ensure the ontology is deep enough to be useful but flexible enough to support multiple designs and verified to ensure that functional specifications are executable. These parameters were met through analysis and selection of top level meta models, followed by the development of lower ontological decompositions for nuclear design using subject matter input to create an easily extendable ontology framework, and the validation and verification of the ontology for nuclear reactor behavior models using Monterey Phoenix. The resulting Data Integration Aggregated Model for Nuclear Deployment (DIAMOND) nuclear ontology empowers the development of innovative nuclear technologies by facilitating the development of a single digital engineering platform to support multiple nuclear energy programs, saving costs, and encouraging collaboration.

TALENT PIPELINE:

Students:

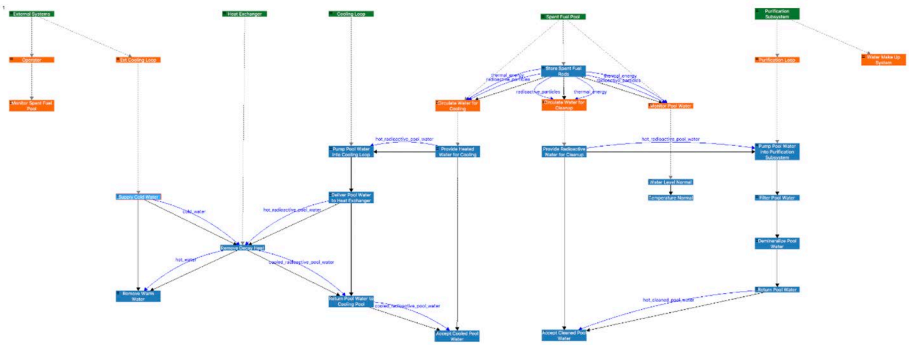
- Matthew Ball, North Carolina State University
- Joel Corporan, Georgia Institute of Technology (Georgia Tech)
- Chara Robertson, North Carolina Agricultural and Technical State University
- Arkasia Wyatt, Norfolk State University

INTELLECTUAL PROPERTY:

One software copyright filed (CW-19-19): DIAMOND, available open source on GitHub: https://github.com/idaholab/DIAMOND.

PRESENTATION:

Ritter, C., J. Browning, L. Nelson, T. Borders, J. Bumgardner, and M. Kerman. 2020. "Digital Engineering Ecosystem for Future Nuclear Power Plants: Innovation of Ontologies, Tools, and Data Exchange. Presented at the 18th Annual Conference on Systems Engineering Research (CSER) (Virtual Conference Oct. 08-10).



Nominal behavior of spent fuel cooling pool (Monterey Phoenix event trace). Green boxes are root events (actors), orange boxes are composite events, and blue boxes are atomic events.