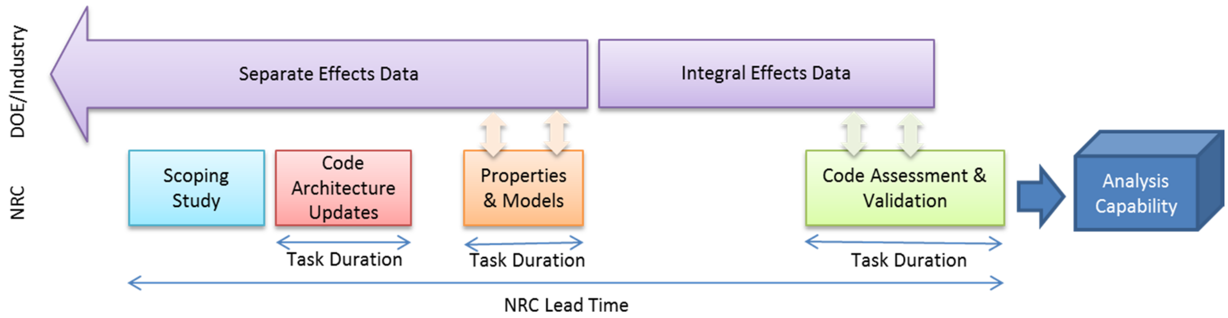
Task 4: Analysis Capability Development

Independent confirmatory analyses are an important part of the Nuclear Regulatory Commission (NRC) review process. Confirmatory analyses provide the staff insight on the phenomenology and potential consequences of transient and accident scenarios. Sensitivity studies also help to identify risk significant contributors to the safety analyses and assist in focusing the staff review. Regulatory Guide 1.70 identifies the standard format and content of safety analysis reports for nuclear power plants and NUREG-0800 identifies the criteria that the staff should use to review the licensees safety analyses. The NRC plans to continue to develop independent confirmatory analysis tools that support robust safety evaluations and provide insights into safety significant factors for each ATF design. Vendor codes used for ATF modeling capabilities will likely be based on smaller data sets than today's Zr-UO_2 models. This will result in greater uncertainty of the results of the safety analyses and the margins to the specified acceptable fuel design limits. For these reasons, confirmatory regulatory tools will be critical to generating confidence in the safety assessment of ATF against all applicable regulatory requirements (see Task 1: 10 CFR Parts 50, 52, and 100 Regulatory Framework, In-reactor Performance reference document for more details). A confirmatory code can be used to independently quantify the impact of modelling uncertainties, supporting more efficient reviews with the potential for fewer requests for additional information. Finally, the experience and insights gained by developing an in-house code can be leveraged in the review of externally developed models and methods, making reviews more efficient and effective.

The staff identified four technical disciplines needing analysis capability development in order to support safety review of topical reports and license amendment requests: fuel performance, thermal hydraulics, neutronics, and severe accidents. Analysis capability development will proceed with similar activities in each area:

- Code development needs will be evaluated with an initial scoping study
- Where necessary, code architecture modifications will be made (e.g., to remove Zr/UO_2 hard wired properties and assumptions or to solve the governing equations for non-cylindrical geometry)
- Where necessary, material properties will be added and new models will be developed
- Integral assessment of the updated codes will be completed and documented.

Below is a generic schematic of tasks associated with developing analysis capability for evolutionary ATF designs. This figure defines the "lead time" and "duration" concepts for analysis capability. Lead time refers to the time required to complete the analysis capability development process and durations refer to the time required for discrete tasks within the process. Both the property and model development and the code assessment and validation tasks require data. Therefore, the lead time is intrinsically linked to the production and availability of data from ongoing testing programs. The figure below illustrates that data is needed for model development and code assessment, but that these tasks also drive data needs. The Memorandum of Understanding with the Department of Energy and Electric Power Research Institute establish mechanisms for the NRC staff to communicate data needs uncovered by model development and code assessment efforts.



The analysis capability development process for revolutionary ATF designs will likely be more iterative than the process for evolutionary ATF designs and some of the tasks may proceed in parallel. This is because it is expected that some code architecture updates and new model needs will only become evident as more data for revolutionary ATF designs becomes available and codes are assessed. As with evolutionary ATF designs, the property and model development and the code assessment and validation tasks require data. Therefore, the duration of these tasks are intrinsically linked to the production and availability of data from ongoing testing programs.

For each discipline, the level of effort to complete these activities will vary based on the characteristics of the ATF design, and the availability of information on the properties and phenomenological behaviors of the fuel, which will be addressed for each discipline in separate reference material.

Although this plan addresses analysis capability development in four different disciplines, there is technical overlap between disciplines, such as the introduction of new material properties. To reduce duplication of effort, the analysis tools will be coupled, allowing codes to send and receive information between each other. For example, neutronics codes can be used to provide fuel performance codes with pellet radial power distribution information as a function of burnup and fuel performance codes can provide neutronics codes with fuel temperature and deformation calculations. Thus, coupling the codes leverages information sharing to improve on the overall analysis capabilities and ensures consistency across codes. The NRC graphical user interface Symbolic Nuclear Analysis Package (SNAP) will be updated as needed to become the interfacing tool between the NRC's suite of analysis tools. Where possible, the NRC will collaborate with DOE to reduce duplication of effort in the area of analysis capability development.