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# A Project Management and Systems Engineering Structure for a Generation IV Very High Temperature Reactor

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## ABSTRACT

*The Very High Temperature Reactor (VHTR) will be an advanced, very high temperature (approximately 1000$^o$ C. coolant outlet temperature), gas cooled nuclear reactor and is the nearest term of six Generation IV reactor technologies for nuclear assisted hydrogen production. In 2001, the Generation IV International Forum (GIF), a ten nation international forum working together with the Department of Energy's (DOE) Nuclear Energy Research Advisory Committee (NERAC), agreed to proceed with the development of a technology roadmap and identified the next generation of nuclear reactor systems for producing new sources of power.*

*Since a new reactor has not been licensed in the United States since the 1970s, the risks are too large for a single utility to assume in the development of an unprecedented Generation IV reactor. The government must sponsor and invest in the research to resolve major first of a kind (FOAK) issues through a full-scale demonstration prior to industry implementation. DOE's primary mission for the VHTR is to demonstrate nuclear reactor assisted cogeneration of electricity and hydrogen while meeting the Generation IV goals for safety, sustainability, proliferation resistance and physical security and economics. The successful deployment of the VHTR as a demonstration project will aid in restarting the now atrophied U.S. nuclear power industry infrastructure.*

*It is envisioned that VHTR project participants will include DOE Laboratories, industry partners such as designers, constructors, manufacturers, utilities, and Generation IV international countries. To effectively mange R&D, engineering, procurement, construction, and operation for this multi-organizational and technologically complex project, systems engineering will be used extensively to ensure delivery of the final product.*

*Although the VHTR is an unprecedented FOAK system, the R&D, when assessed using the Office of Science and Technology Gate Model, falls primarily in the 3$^{rd}$ - Exploratory Development, 4$^{th}$ – Advanced Development, and 5$^{th}$- Engineering Development stages of maturity rather than in the basic and viability stages. Therefore the R&D must be controlled and project driven from the top down to address specific issues of feasibility, proof of design or support of engineering. The design evolution must be through the systems approach including an iterative process of high-level requirements definition, engineering to focus R&D to verify feasibility, requirements development and conceptual design, R&D to verify design and refine detailed requirements for final detailed design.*

*This paper will define a framework for project management and application of systems engineering at the Idaho National Engineering and Environmental Laboratory (INEEL). The VHTR Project includes an overall reactor design and construction activity and four major supporting activities: fuel development and qualification, materials selection and qualification, NRC licensing and regulatory support, and the hydrogen production plant.*

## Introduction and Background

Electricity demand in the United States is expected to grow sharply in the 21st century, requiring new generation capacity. Even if ambitious assumptions are made regarding implementation of energy efficiency practices and technologies, forecasts indicate that the United States will need significant new generating capacity by 2025[1]. This growth, which powers economic expansion, would require the United States to build substantial number of new power plants over the next two decades. Otherwise, the U.S. and other industrialized nations will face significant energy shortages in coming decades.

To present solutions to the global demand for electricity, the Generation IV International Forum (GIF), a ten nation international forum working together with DOE's Nuclear Energy Research Advisory Committee (NERAC), agreed to proceed with the development of technology roadmap and identified six Generation IV nuclear reactor systems. One of these reactor system concepts, the Very High Temperature Reactor (VHTR) System, is also uniquely suited for production of both electricity and hydrogen without the consumption of fossil fuels or the emission of greenhouse gases.

"Expanded use of hydrogen as an energy carrier for America could help address concerns about energy security, global climate change, and air quality. Hydrogen can be derived from a variety of domestically available primary sources, including fossil fuels, renewables, and nuclear power."[3] The U.S. hydrogen industry currently produces nine million tons of hydrogen per year for use in chemicals production, petroleum refining, metals treating, and electrical applications, and the current use is experiencing rapid growth as more and more hydrogen is used to convert the lower-cost Western hemisphere heavy crude oils to gasoline. With a larger supply of hydrogen, the production of liquid fuels per barrel of oil could be increased by up to 15%, which would significantly reduce our imported crude oil.

Steam reforming of methane accounts for more than 95% of the current hydrogen production in the U.S. Unfortunately, steam methane reforming diverts valuable natural gas from home heating uses and releases large quantities of carbon dioxide into the atmosphere. A much more environmentally friendly method of producing hydrogen uses electrolysis of water at high temperatures in conjunction with nuclear heat. The current growth in hydrogen demand is already sufficient to justify the development of electrolysis methods. As efficient fuel cells are developed and the transportation sector is revolutionized, the worldwide demand for hydrogen will eventually rival that for electricity.

Given these additional energy needs, it is appropriate to start the development of nuclear energy systems designed for large-scale production of hydrogen and electric power. However, even though new energy systems such as the VHTR are critical to the U.S., new design and construction in the U.S. Nuclear Industry has essentially been at a standstill since the 1970's. This has been primarily due to public perceptions of nuclear safety and high economic costs. Moreover, utility companies have been reluctant to assume the risks involved in new U.S. power plant design and construction. The thirty plus year de facto moratorium has left the nuclear industry infrastructure in an extremely weakened state.

To enable the deployment of new, advanced nuclear power plants in the United States in the relatively near-term – by the year 2020 – it is essential to stimulate the U.S. nuclear industry, pool resources through industry partnerships and demonstrate the new, untested Federal regulatory and licensing processes for the siting, construction, and operation of new plant designs. Independent expert analysis commissioned by the DOE and carried out by the NERAC, has also shown that the research and development of near-term advanced reactor concepts that offer enhancements to safety and economics are needed to enable these new technologies to come to market.

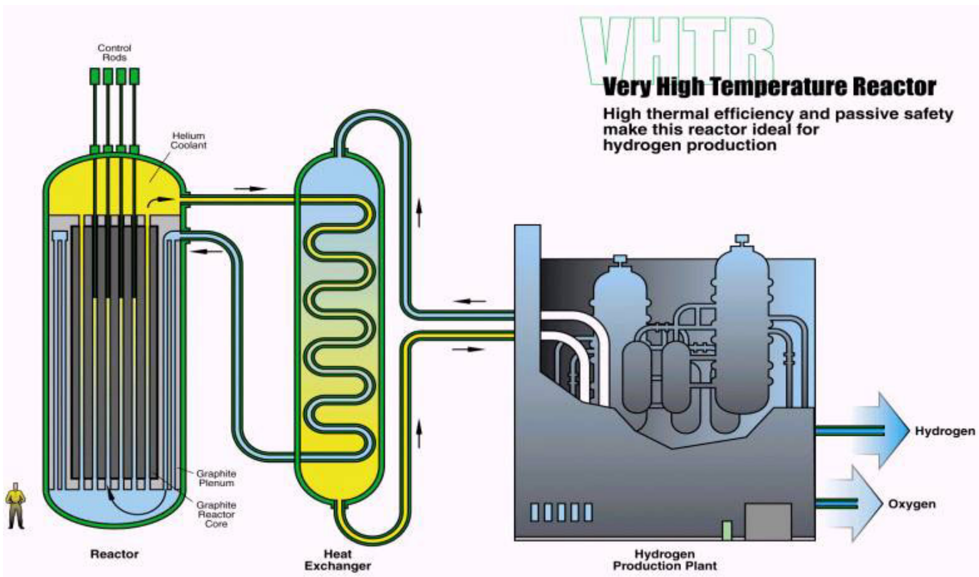
## Government Lead

Historically industry has not assumed the high risks on unprecedented, highly technical, first-of-a-kind (FOAK) systems. The government must sponsor and invest in the research to resolve major FOAK issues through full-scale demonstration prior to industry implementation. The Department of Energy (DOE) has the primary responsibility in the U.S. for implementation of a new demonstration Generation IV reactor. DOE's primary mission for the Next Generation Nuclear Plant (NGNP), the U.S. VHTR, is to demonstrate nuclear reactor assisted cogeneration of electricity and hydrogen while meeting the Generation IV goals for safety, sustainability, proliferation resistance and physical security, and superior economics. Objectives for the NGNP demonstration project include:

- Demonstrate a full-scale prototype VHTR by the year 2020
- Demonstrate high-temperature Brayton Cycle electric power production at full scale
- Demonstrate nuclear-assisted production of hydrogen (with about 10 % of the heat)
- Demonstrate by test the exceptional safety capabilities of the advanced gas cooled reactors
- Obtain an NRC License to construct and operate the NGNP, to provide a basis for future performance-based, risk-informed licensing
- Support the development, testing, and prototyping of hydrogen infrastructures such as refueling stations, the "Freedom Car" initiative, petrochemical extension, heavy crude oil or tar sands "sweetening," and other industrial hydrogen applications

## NGNP Description

The NGNP Generation IV reference concept is a helium-cooled, graphite moderated, thermal neutron spectrum reactor with an outlet temperature of 1000°C or higher. Although final selection of the reactor core technology will be made during the Initiation Phase, the reactor core is envisioned to be a prismatic graphite block gas cooled concept (or potentially a pebble bed reactor). The NGNP will produce both electricity and hydrogen using an intermediate heat exchanger (IHX) to transfer the heat to either a hydrogen production technology test-bed or a gas turbine. This will require that an IHX and primary gas circulator be located in an adjoining power conversion vessel. Figure 3-1 provides a conceptual schematic of the NGNP.




The reactor thermal power (400 - 600 MWt) and core configuration will be designed to assure passive decay heat removal without fuel damage during accidents. The fuel cycle will be a once-through, very high burnup, low-enriched uranium fuel cycle.

One or more processes will use the heat from the high temperature helium coolant to produce hydrogen. The first process of interest is the thermo-chemical splitting of water into hydrogen and oxygen. The primary candidate thermo-chemical process is the sulfur-iodine (IS) process. The second process of interest is thermally assisted electrolysis of water. The high efficiency Brayton cycle enabled by the NGNP may be used to generate the hydrogen from water by electrolysis. The efficiency of this process can be substantially improved by heating the water to high temperature steam before applying electrolysis. The waste heat from the pre-cooler and inter-cooler of the Brayton cycle, therefore, can be used to further improve the efficiency of hydrogen production.

## NGNP Project Scope

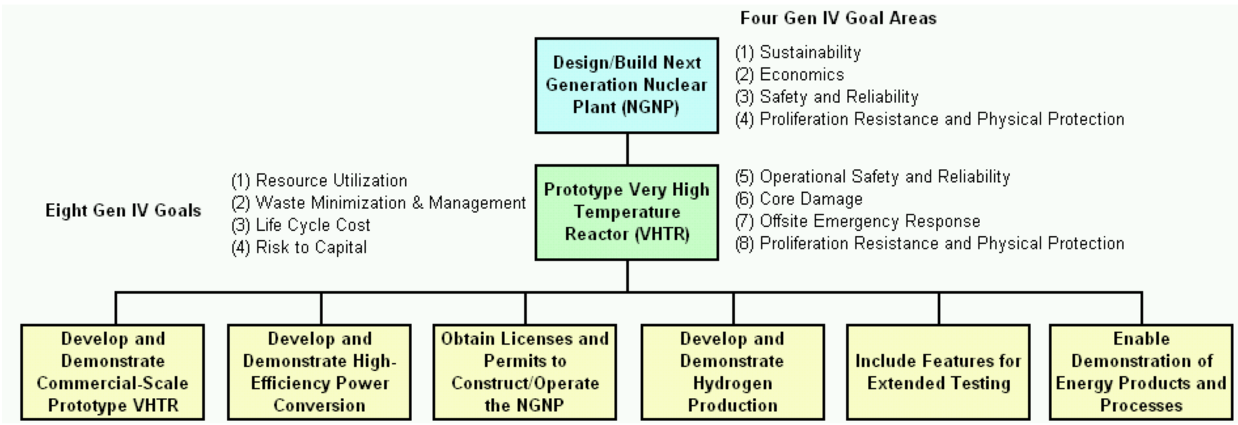
The NGNP Project includes an overall facility design and construction activity and four major supporting activities:

- The fuel development and qualification project
- The VHTR materials selection and qualification project
- The NRC licensing and regulatory support activities
- The nuclear hydrogen production demonstration process

The Scope of the Operational Project will be further defined as the project progresses.

## High Level Functions and Requirements

The high-level functions and requirements (F&Rs) provide a foundation to define lower level functions and additional performance requirements at each successive lower level of the design. In addition, the high-level F&Rs provide a framework for agreement by partnering organizations in achieving a roadmap to meet a middle of the next decade goal for operations of the NGNP. Finally, the high-level F&Rs provide the initial bases on which to build additional detailed functions and requirements that will result in an operational NGNP. The high-level goals and objectives are represented below.




Since the NGNP is to provide a prototype for the commercial power industry, commercially applicable federal regulations (10 CFRs, 40 CFRs, etc.), industry consensus standards (ASME, IEEE, ISA, etc.) and Nuclear Regulatory Commission requirements shall be used to the extent possible to develop the requirements and procedures for the project. Federal environmental and safety regulations will also be included.

## Project Management and Systems Engineering Structure

The NGNP Project will be made up of many different contributors and will be structured as an international public-private partnership under a common management structure. To be successful in meeting project technical, cost, and schedule goals, the control, coordination, and management of schedule, budget, scope and all elements of work must be focused through a single point of control. Project management is a systematic approach to managing projects in which authority, responsibility, and accountability are focused under an integrative project management structure with a single point of control. Project management was derived from the system engineering process and partnered with system engineering is a natural combination for managing the implementation of major, highly technical and complex projects.

Project management is responsible for the overall project and concentrates on planning, organizing, directing, and monitoring and control of the project. The Project Manager receives the mission, goals, and objectives from DOE, the NGNP sponsor, and passes those elements down to the project team through plans, organization, delegation of responsibilities, directions, scopes, budgets and controls and requirements resulting in the implementation of the project. As the project progresses, the Project Manager receives reports and feedback from the assigned responsible team members on progress, issues, and accomplishments and in turn reports the status of the project back to the Project Sponsor. The graphic below shows the interrelationship between functions of the project management team and the system engineering team.

Systems engineering is utilized to implement the technical requirements for the project by applying scientific and engineering efforts to transform an operational need into a defined system configuration through the top-down iterative process of requirements analysis, functional analysis and allocation, synthesis, design optimization, test and evaluation and validation. The following summarizes the systems engineering approach for the Next Generation Nuclear Plant:

- Creation of seamless management: one project – government, industry, universities and international partners
  - Operate NGNP as a single project activity with seamless management and execution

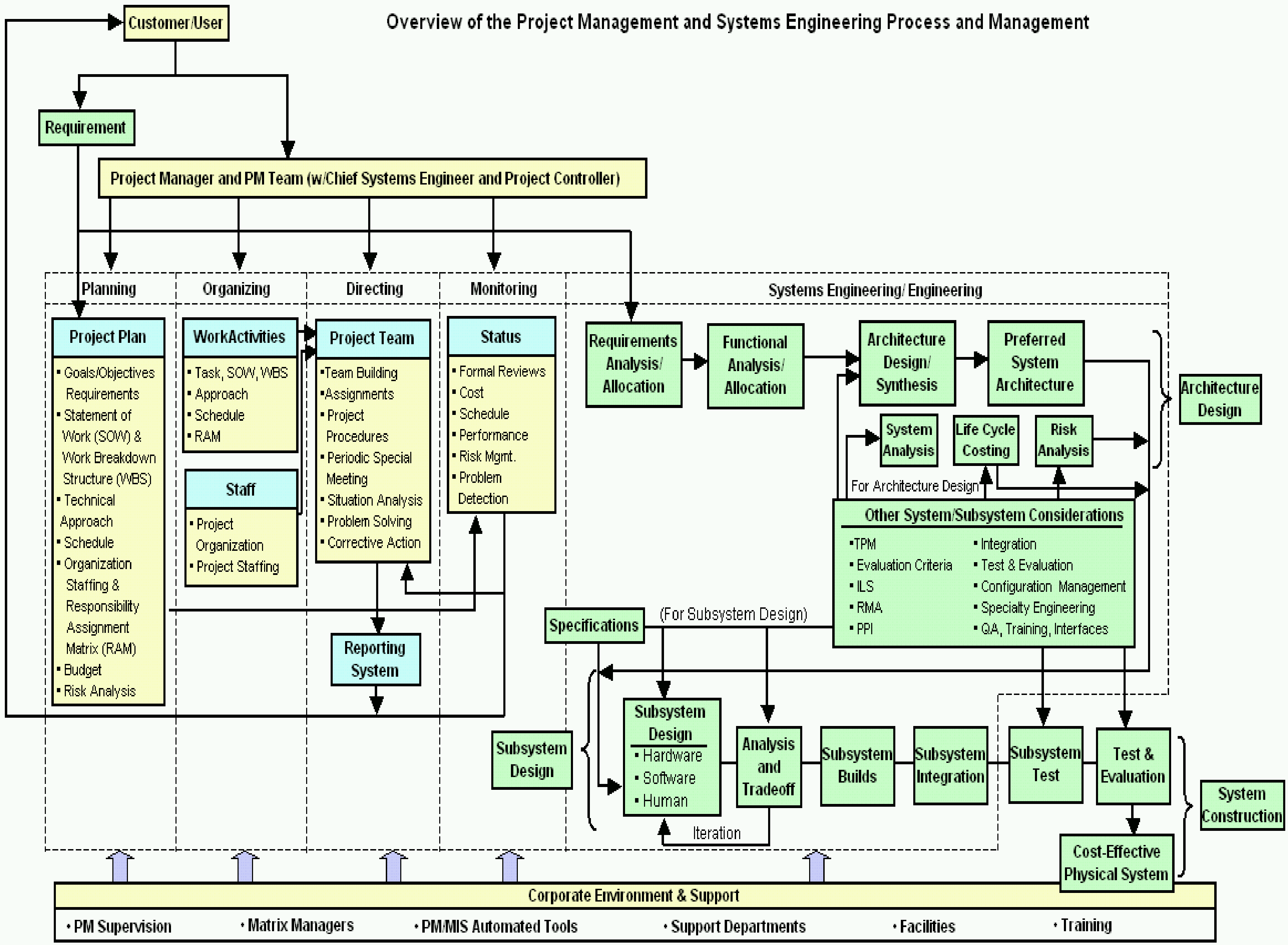
    - Collaborate on research and development, and share findings while protecting intellectual property
    - Take maximum advantage of standard tools to enable inter-participant collaboration.

- Focus on advanced NGNP development
    - Focus on fuels and high-temperature materials research
    - Utilize full-system, component, or scenario simulations
    - Validate simulations by rigorous correlation with constrained experiments and archival data

- Create problem-solving environments
    - Provide NGNP development support
    - Ensure state-of-the-art collaboration tools
    - Develop laboratory-computing environment

- Encourage strategic alliances and collaboration
    - Leverage international initiatives, GIF, NERAC subcommittees
    - Collaborate with the best R&D projects of other DOE laboratories, other agencies, universities, industry, and foreign participants
    - Attract the best researchers in the key disciplines for reactor and hydrogen applications.

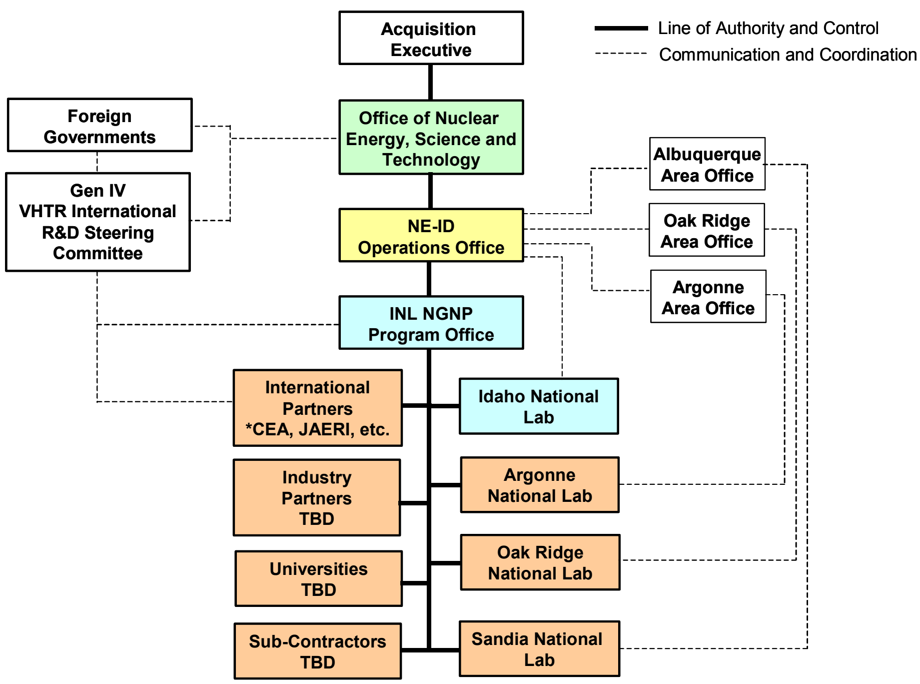
Overview of the Project Management and Systems Engineering Process and Management



Initial Project Management and Systems Engineering efforts will concentrate on the definition and development of the complex project that includes industry, international, laboratory, university, and other participants. The need for an effective project can be seen from the complex host of participants not unlike the International Space Station Project. Quality, Risk, and other Projects will have to be effectively integrated into the NGNP Project. Systems Engineering can play a major role in the integration of the Project elements. With the support of systems engineering and project management, ultimate success will be achieved.

## NGNP Organization and Interfaces

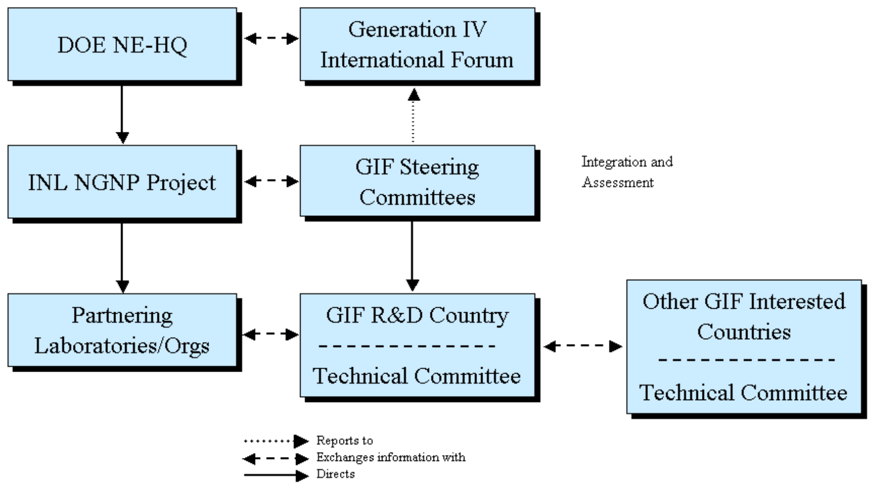
The NGNP Project will be structured as an international public-private partnership under a common NGNP management structure. The project is sponsored by the DOE Office of Nuclear Energy, Science and Technology and is managed under the Nuclear Energy Project's Advanced Nuclear Research (NE-20). To ensure a single point of control an NGNP Project Office will be established. The NGNP Project Office will be responsible for coordination, directing, and managing participating partners, including but not limited to: Industry and international partners, other DOE laboratories and universities. The schematic below represents the management arrangement of various partners and members of the NGNP Team. Solid lines represent flow of responsibility and the dotted lines indicate where communication, coordination, and support are required.




Support from other DOE Labs, universities, international, industry and architectural engineering subcontractors will be obtained where their expertise can benefit the NGNP. It is important that all project related budget and work by these contributors be controlled through the NGNP Project Office in order to maintain a single point of control. The primary interfaces occur both among the DOE offices and among the laboratory participants.

Industry partners will include U.S. power generation companies whose role will be to provide current and practical project input to assure that the prototype nuclear plant will be licensable and representative of future marketable reactor system designs. The companies will also support design, permitting, licensing, construction, startup, and operation activities. Determination of specific partners will be made during the project initiation and Conceptual Design Phases and documented in the formal Acquisition Strategy by or before CD-1.

Industry partnerships will be conducted through formal competitive performance based contracts. The contracts will include provisions for cost sharing. Mechanisms within the subcontracts will provide protection of intellectual property rights. If the industry partners participate beyond R&D activities and into the implementation phase of competitive design and construction contracts, provisions shall be included for equitable consideration of use of the property rights. Industry participation will also be gained through the Industry Advisory Group.




International partnerships will be formed around a limited number of key technology needs. International partners, with DOE, are expected to include the Generation IV International Forum countries such as France, Japan, Great Britain, South Korea, and others who have an interest in participating financially and collaborating on research and development activities, concept definition, and analysis that can also be used to in the development of a VHTR system in both the U.S., and their own country. Coordination of the international partnerships will be aligned through the Generation IV International Forum and GIF R&D Steering Committees by selection of specific R&D projects as needs are identified. Funding for the R&D effort will come from the GIF country. Intellectual property will remain with the performing country. Sharing with interested GIF countries on specific R&D findings will be encouraged through formal agreement with the GIF country. The GIF R&D Steering Committee will coordinate efforts on behalf of the GIF.

The proposed organization and conduct of the R&D work by international partnerships will be achieved by combining two concepts, as follows:

- Assignment of specific R&D projects for development and/or demonstration of key technologies to an interested GIF country through the GIF VHTR R&D Steering Committee. This activity is currently in progress in the Steering Committee.
- Continuous concept integration and assessment by the GIF Steering Committee.

The GIF will initiate the formation of international partnerships through government-to-government agreements. The framework for this collaboration is already in place through the use of bi-lateral and multi-lateral agreements of the Generation IV International Forum. International participation in R&D efforts will be through the framework of the GIF R&D Steering Committee. Memoranda of Agreement are currently in place for some of the participating GIF countries. Additional work will need to be done on current agreements to include provisions for the partners to work directly with the partnering DOE Laboratories.

## Laboratory Partnerships

Memorandum of Agreements will be established between NE-ID and the local DOE office for each participating laboratory. This agreement will define the roles, responsibilities, and expectations of the local offices needed to support the NGNP Project. The MOA will provide the framework for DOE field Office oversight and coordination of the partner laboratories' efforts to support the NGNP Project work. All funding for this work is provided by NE-HQ, through NE-ID to the NGNP Project Office for execution of the NGNP. Subsequent funds transferred from the Project Office to the participant laboratories are processed through the host DOE offices.

Each laboratory will be responsible for delivering specific products and deliverables necessary to complete the NGNP. Each laboratory will prepare approved execution plans, for performing their assigned work, incorporating the requirements of the execution plan above them in the document hierarchy. A Site Technical Lead will be assigned at each partnering laboratory where responsibilities for activities are focused at a single working level point of contact. The person serving as the point of contact will report to the NGNP Project Director on work activities supporting the NGNP. The Site Technical Lead will keep the Project informed of activities at his/her site and will gain overall project information through participation in the semiannual NGNP Project reviews. As planning progresses and the Work Breakdown Structure is finalized, the work will be assigned as discrete pieces of work as broken down into work packages in the WBS. A work package manager will be assigned responsibility for each WBS work package.

## University Partnerships

A goal of significant importance for the NGNP is to stimulate university nuclear R&D projects. Therefore the use of universities to support the NGNP R&D work is essential. Partnerships with universities will be conducted through formal sub-contracts. Mechanisms within the subcontracts will provide protection of intellectual property rights. One of the goals of university partnerships is to foster and stimulate student research and development work.

## Advisory Groups

Several technical advisory committees will be established as part of the NGNP management team. These committees provide managerial and technical assistance to the project team and a firm connection to the reactor community and power industry. Additionally, the NGNP Project Technical Advisory Team, which is made up of technical advisors from partnering laboratories, their respective Laboratory Directors and representatives of other R&D partners including international and industry, will provide technical oversight of the project. A charter will be developed for each advisory group that outlines structure, duties, procedures, protocol, and functions.

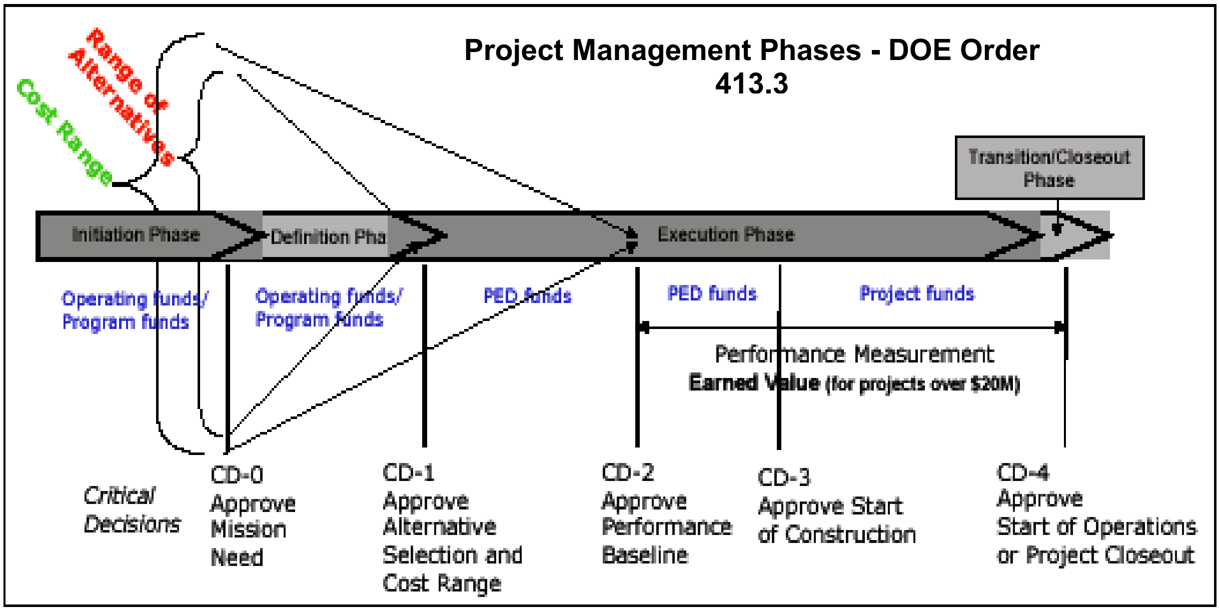
## Acquisition Approach

The DOE's method of applying industry's proven principles of project management and system engineering is incorporated through Order 413.3, which is required for acquisition of all capital assets. For the purposes of pre-decisional planning, it is assumed that the acquisition of this project will be in accordance with DOE Order 413.3.

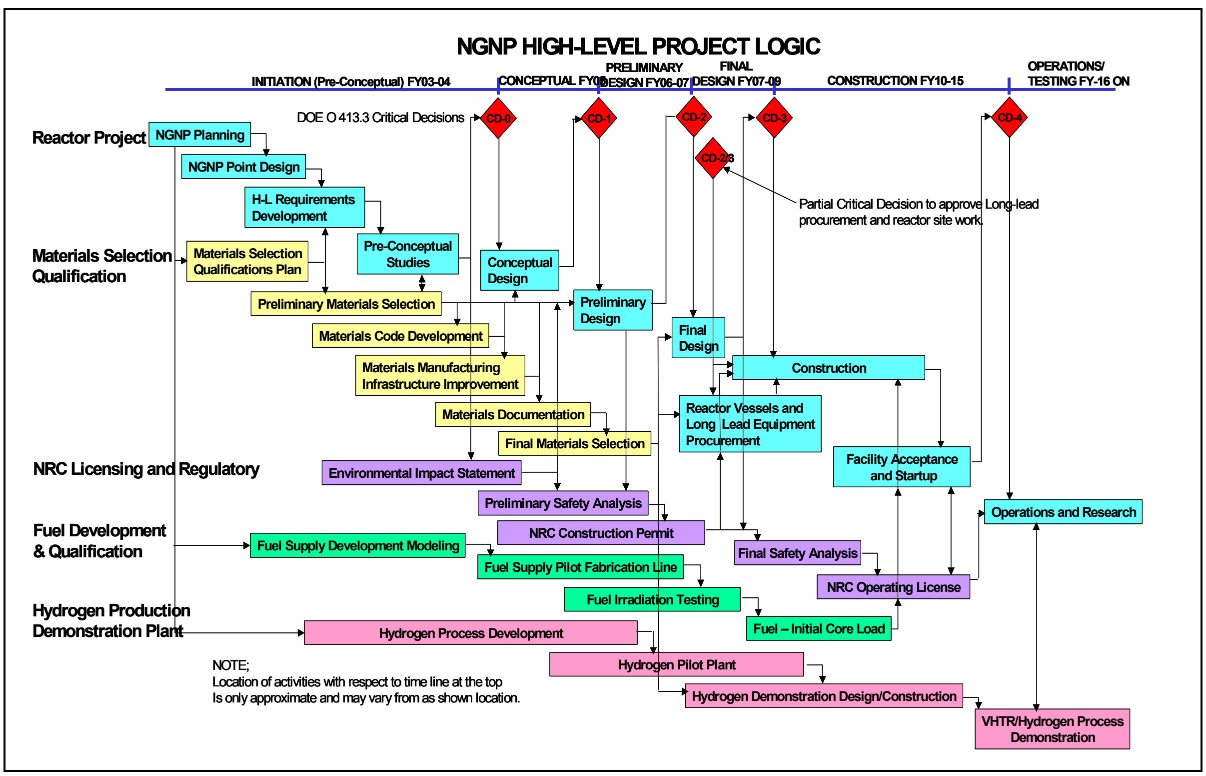
DOE O 413.3 and commercial project management systems use a systems approach to turn a complex and undefined need into a finished product or facility. Projects begin with a broad need, a rough order magnitude cost range and progress through logical steps of higher maturity. With each consecutive phase, scope is better-defined, requirements definition is re-iterated and cost estimates and schedules become progressively more accurate. Quality gates, or critical decisions in the case of O 413.3, ensure readiness to progress to the next phase. Thus complete definition, mature planning, and final decisions are not expected at the beginning, but evolve through an iterative and systematic process. Application of a project management system ensures that a quality plan and implementation strategy is in place and risk is managed though the end of the project.

The figure above illustrates project phases critical decisions between phases. During each phase another iteration of requirements definition, project documentation, and designs with a greater level of detail than the previous phase are developed.

DOE Order 413.3 does not require documentation of the formal overall strategy for procurement until the end of Conceptual Design and CD-1. Special strategies are possible under Order 413.3 as long as they are covered in the formal approved Acquisition Strategy. However, to provide a basis for pre-conceptual planning and budgeting, a traditional acquisition process has been assumed. This process consists of Pre-Conceptual Studies during the Initiation Phase, Conceptual Design during the Definition Phase, combined Preliminary and Final Design and Construction during the execution phase, and systems operational and startup testing and facility acceptance during the Transition and Closeout Phase.




The schematic below illustrates the major project activities (including engineering, procurement and construction, fuel development and qualification, materials selection and qualification, NRC licensing and regulatory compliance, and nuclear hydrogen production technologies) showing the high-level logic on an assumed time line. This schematic considers the systems approach that is specified in DOE O 413.3, providing for

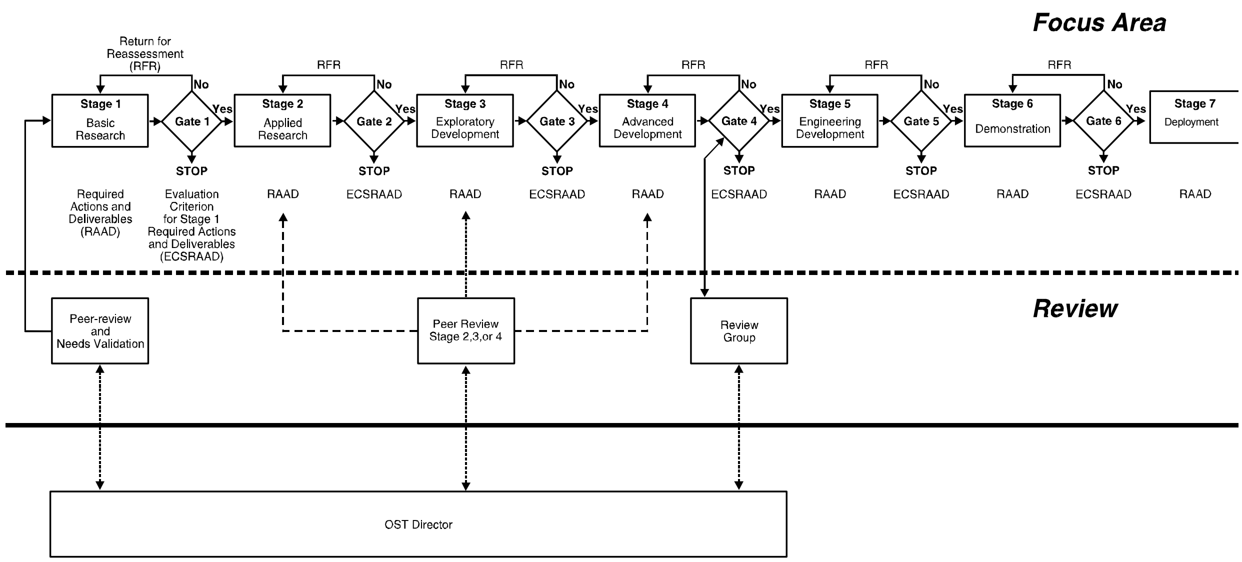



requirements analysis with iterations between phases, functional analysis, alternatives analysis, design synthesis to arrive at a preferred systems design before going on to detailed design.

## Research and Development

Although the VHTR is an unprecedented FOAK system, the basic technology for the NGNP has been established in former high temperature gas-cooled reactor plants (DRAGON [England], Peach Bottom Unit 1 [U.S.], Arbetisgemeinschaft Versuchsreaktor [Germany], Thorium Hochtemperatur Reaktor [Germany], Fort St. Vrain [Colorado]). In addition, the technologies for the NGNP are being advanced in the Gas Turbine-Modular Helium Reactor (GT-MHR) Project and the pebble bed and prismatic reactor (PBR and PMR) International Near-Term Deployment projects. Furthermore, the Japanese HTTR and Chinese HTR-10 projects are scaled reactors demonstrating the feasibility of some of the planned NGNP components and materials. (The HTTR is expected to reach a maximum coolant outlet temperature of 950°C in 2003.) The NGNP will advance the technology to 1000$^{o}$C coolant outlet temperature, along with advanced material, fuel, power conversion, and heat exchanger requirements, by demonstrating a commercial scale reactor, rather than simply confirming the basic feasibility of the concept.

Therefore the R&D, when assessed using the Office of Science and Technology Gate Model, falls primarily in the 3$^{rd}$ - Exploratory Development, 4$^{th}$ – Advanced Development, and 5$^{th}$- Engineering Development stages of maturity rather than in the basic and viability stages. And, the R&D must be controlled and project driven from the top down to address specific issues of feasibility, proof of design or support of engineering. The design evolution must be through the systems approach including an iterative process of high-level requirements definition, engineering to focus R&D to verify feasibility, requirements development and conceptual design, R&D to verify design and refine detailed requirements for final detailed design.




Research and development for the NGNP project follows the prerequisite of completing a point design and preconceptual engineering studies to evaluate and identify the bounding operational conditions and parameters (temperatures, pressures, radiation level, etc.) that will determine technical and functional requirements. These technical and functional requirements provide the bases for material requirements, fuel requirements and other areas of R&D.

The NGNP R&D project consists of five major areas. To facilitate integration into the NGNP R&D project activities and collaboration with GIF international partners, the five categories follow those established through the GIF VHTR R&D Steering Committee. All R&D areas address crucial feasibility and performance issues and are as follows:

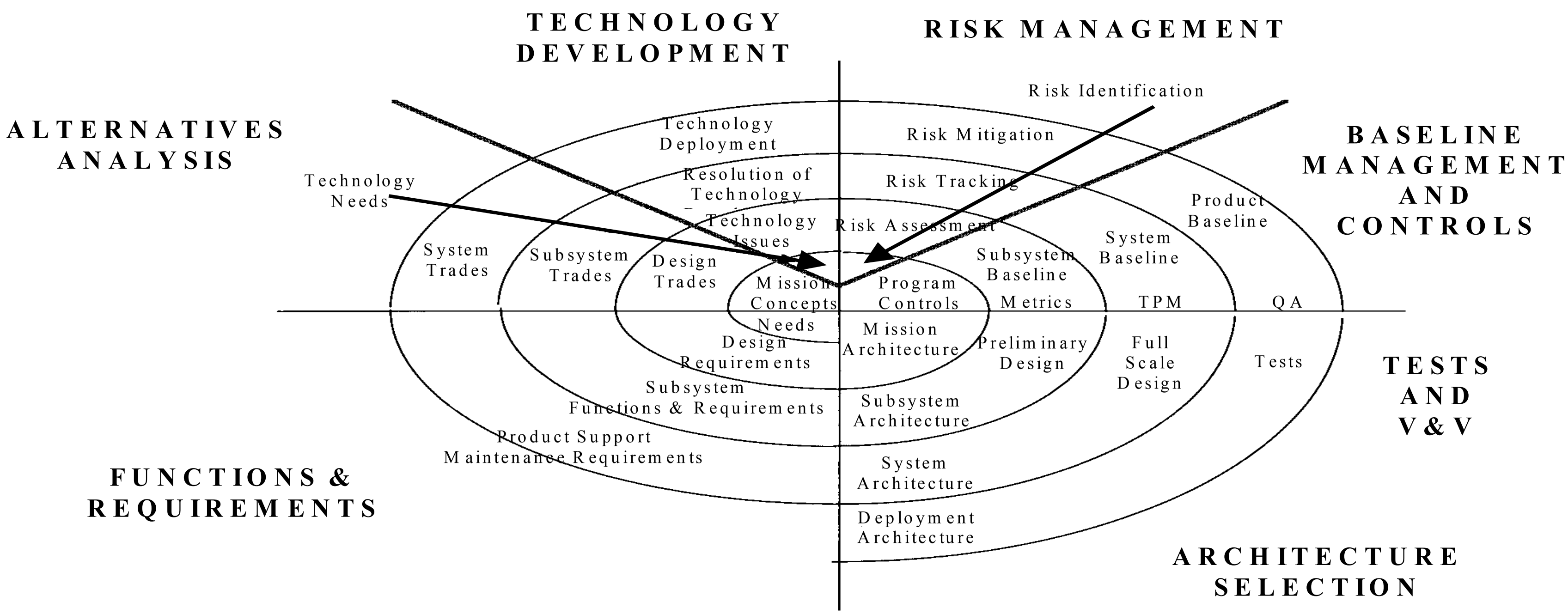
- System Design & Evaluation and Safety & Integration – Definition of a design, operating temperatures and parameters while maintaining passive safety requirements, and other safety issues such as coupling nuclear systems and hydrogen production.

- Fuel Development and Qualification – Development of advanced coated fuel particles with adequate very high temperature potential
- Materials and Components – Selection of structural materials for the reactor and for the Sulfur Iodine (S-I) process, development of crucial components such as the intermediate heat exchanger between the reactor and the S-I process, and demonstration of adequate performance in order to qualify the materials under commercial standards and NRC regulations.
- Hydrogen Production Technologies – Development and optimization of the S-I hydrogen generation process or alternate processes, definition and validation of the reactor/process coupling approach
- High Performance Helium Turbine – Development of high performance helium turbine and other crucial components of Brayton conversion systems, and performance optimization of the balance of plant.

## Development Model

The VHTR lends itself well to the spiral life-cycle model with ever increasing focus from FOAK R&D towards the end product on the outer bands. The spiral below has been enhanced to identify more activities and functional areas than previous versions of the model. The model focuses on additional aspects and the integration of systems engineering processes and project management with systems engineering identified in the entire life-cycle and in areas including program and project management support.

# Next Generation Nuclear Plant
# PROJECT LIFE-CYCLE MODEL



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# Biography

## Edward J. Gorski

Edward J. Gorski is a systems engineering in the Department of Systems and Decision Science at the INEEL. He provides systems engineering support to the Next Generation Nuclear Plant Project and the Advanced Gas Reactor Fuel Development and Qualification Project. Previously, Edward served as systems engineer for the INEEL Spent Nuclear Fuel Project.

His prior nuclear experience includes commercial nuclear power systems engineering at the Tennessee Valley Authority nuclear plants, PSE&G Salem and Hope Creek nuclear plants, Department of Energy Office of Environmental Management DOE Headquarters, and the National Nuclear Security Administration at the DOE Pantex Plant.

## Dennis J. Harrell

Dennis is a PMI certified project manager and a licensed Architect in the Department of Systems and Decision Science at the INEEL. He provides project management support for the initial planning and start-up of the Next Generation nuclear Plant, a VHTR at the INEEL. Previously, Dennis served as a project manager on the Sodium-Bearing Waster Treatment Plant project at the INEEL.

His prior nuclear experience includes approximately 20 years at the INEEL in construction engineering, project engineering and project management. Major INEEL nuclear projects Dennis has worked on include: the New Waste Calcining Facility, the Six Calcined Solids Storage Facility, and the Fuel Processing Restoration Project.

## Finis H. Southworth

Finis H. Southworth is the department manager of Systems and Decision Science. He provides system science & analysis, decision analysis, and systems integration for R&D at the INEEL. He is the Co-chair for the Generation IV International Forum Very High Temperature Gas Cooled Reactor Steering Committee for the U.S. Department Of Energy; he provides project management for development, design, and construction of Generation IV reactor system. Previously, Finis served as Technical Director of the Generation IV Gas Cooled Reactor Systems Technical Working Group.

Before coming to the INEEL, Finis was the manager of systems planning for the Florida Power and Light Company where he served as a member of the CEO/Chairman of the Board's Strategic Planning Team. Finis has more than 30 years professional experience in commercial nuclear fuel management and planning, nuclear plant operations and maintenance, nuclear R&D, total quality management, systems engineering, and graduate-level teaching. Finis has a Ph.D. in Nuclear Engineering Sciences from the University of Florida, and he is an Adjunct Faculty member at Idaho State University and the University of Idaho.