Document ID: PLN-1484
Revision ID: 1
Effective Date: 04/17/06

**Plan**

Project No. 23841

# Advanced Gas Reactor Fuel Development and Qualification Program: Project Execution Plan


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| 1. Document Identifier: PLN-1484 | 2. Project File No. (optional): 23841 | 3. Revision No.: 1 | |
| 4. Document Title: Advanced Gas Reactor Fuel Development and Qualification Project Execution Plan | | | |
| 5. Comments: | | | |

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## REVISION LOG

| Rev. | Date | Affected Pages | Revision Description |
|---|---|---|---|
| 0 | 09/21/05 | All | Initial issue. |
| 1 | 04/17/06 | All | Annual Update |
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# ACRONYMS

| | |
|---|---|
| AFCI | Advanced Fuel Cycle Initiative |
| AGR | Advanced Gas Reactor |
| ASME | The American Society of Mechanical Engineers |
| ATR | Advanced Test Reactor |
| BCP | baseline change proposal |
| BEA | Battelle Energy Alliance |
| BWXT | BWX Technologies, Lynchburg |
| CFR | Code of Federal Regulations |
| CO | Carbon monoxide |
| DOE | U.S. Department of Energy |
| DOE-ID | DOE Idaho Operations Office |
| DOE-NE | DOE Office of Nuclear Energy, Science, and Technology |
| EM | Execution manager |
| FCF | Facility Change Form |
| FY | Fiscal Year |
| GA | General Atomics |
| HQ | Headquarters |
| INL | Idaho National Laboratory |
| ISMS | Integrated Safety Management System |
| LCB | Life cycle baseline |
| LEU | Low enriched uranium |
| M&O | Management and operations |
| MCP | Management Control Procedure |
| DOE-NE | DOE HQ Office of Advanced Nuclear Research |
| NGNP | Next Generation Nuclear Plant |
| NQA-1 | ASME Quality Assurance Requirements for Nuclear Facility Applications |
| NTD | National Technical Director |
| ORNL | Oak Ridge National Laboratory |
| PBR | Pebble-bed reactor |
| PDD | Program Description Document |
| PEP | Project Execution Plan |
| PICS | Performance Information Collection System |

| | |
|---|---|
| PIE | Post irradiation examination |
| PLN | Plan |
| PMR | Prismatic modular reactor |
| PRC | Performance Results Corporation |
| PRD | Program Requirements Document |
| QA | Quality Assurance |
| QPP | Quality Program Plan |
| R&D | Research and development |
| TD | Technical director |
| TFR | Technical and Functional Requirements |
| TRISO | Tri-isotropic (multilayered fuel-particle coating consisting of pyrolytic carbon and silicon carbide) |
| UCO | Uranium oxycarbide |
| VHTR | Very-High-Temperature Gas-Cooled Reactor |
| WBS | Work break down structure |
| WPM | Work package manager |

# 1. OVERVIEW

## 1.1 Introduction

The Project Execution Plan (PEP) supports DOE's policy to promote disciplined upfront planning, realistic estimates of cost, schedule and performance, and straightforward communication with DOE and INL senior management. The primary requirements for this PEP are contained in DOE Order O 413.3, "Program and Project Management for the Acquisition of Capital Assets," and its accompanying manual. The PEP will be updated periodically to reflect new information and program planning changes. The PEP can be changed without formal review and approval if the revision incorporates only baseline changes that have been approved through the baseline change control process.

The primary goal of this research and development (R&D) Program is to successfully demonstrate that coated-particle fuel can be fabricated to withstand the high-temperature, high-burnup, and radionuclide confinement requirements of the Generation IV Very-High-Temperature Gas-Cooled Reactor (VHTR). The end result of the Program activities will be a qualified coated-particle fuel that can be used in the Generation IV VHTR. The Program will produce a baseline qualification data set that will support the licensing and operation of the VHTR for commercial energy production in the United States. The R&D efforts are also intended to reduce the market entry risks posed by technical uncertainties associated with the coated-particle fuel production and qualification.

## 1.2 Purpose and Scope

This PEP defines the program, the organization, and the set of management controls necessary to execute the Advanced Gas Reactor (AGR) Fuel Development and Qualification Program (the Program) activities performed by or for the Idaho National Laboratory (INL). The PEP is consistent with the long-term mission contained in INL/EXT-05-00465, Technical Program Plan for the Advanced Gas Reactor Fuel Development and Qualification Program, Revision 1, dated August 2005. In addition, the PEP describes the tools and resources implemented at the INL to augment the Advanced Gas Reactor Fuel Development and Qualification Program Annual Implementation Plan, PLN-1586, *Advanced Gas Reactor Fuel Development and Qualification Project FY-06 Annual Implementation Plan*.

Completion of the AGR Program requires work activities to be performed by Oak Ridge National Laboratory (ORNL) and subcontractors. As the lead laboratory, INL provides direction and requirements for these activities. This PEP acknowledges those interfaces but does not attempt to report any specifics of other organizations since the purpose of this document is to address INL program execution.

## 1.3 Mission Need

The DOE has initiated programs to revitalize nuclear power generation growth in the United States, in support of the National Energy Policy. Principal among these is the Generation IV Nuclear Energy Systems Roadmap, which defines a technology development path for deployment of nuclear systems by 2030. The DOE Generation IV Program has identified the gas-cooled VHTR concept as uniquely suited for producing hydrogen without the consumption of fossil fuels or the emission of greenhouse gases.

Among the Generation IV concepts, the VHTR is the nearest-term hydrogen production system. VHTR-based reactor concepts utilize inherent passive features to replace powered active reactor safety systems. This reduces the organizational and operational complexities associated with operation of active reactor safety systems, thereby increasing the reactor safety.

The AGR Fuel Development and Qualification Program was established to achieve the following overall goals discussed in the *Technical Program Plan for the AGR Fuel Development and Qualification Program* (INL/EXT-05-00465):

- Provide a baseline fuel qualification data set in support of the licensing and operation of a VHTR. The baseline fuel form is to be demonstrated and qualified for a time-averaged peak fuel centerline temperature of 1250$^{o}$ C.
- Support near-term deployment of a VHTR for commercial energy production in the United States by reducing market entry risks posed by technical uncertainties associated with fuel production and qualification.
- Utilize international collaboration mechanisms to extend the value of DOE resources.

## 1.4 Background and History

In FY 2003, the DOE Office of Nuclear Energy, Science and Technology (NE) established a technical program plan for an advanced gas reactor (AGR) fuel development and qualification program for coated-particle fuel as part of the Next Generation Nuclear Plant (NGNP) initiative. This program plan was significantly revised in FY 2005.

The program is tasked to develop and qualify the fuel to support design and construction of a VHTR using helium coolant in a core of coated-particle fuel. Gas reactor technology in the United States offers the potential for high efficiency, environmentally benign power production, and process heat applications at a competitive cost in smaller modular plants.

The Program is developing a uranium oxycarbide (UCO) fuel engineered to prevent carbon monoxide (CO) formation and kernel migration. The fuel contains UCO fuel kernels that are coated with multi-layers of pyrolytic carbon and silicon carbide. Early efforts will focus on manufacturing and testing the fuel design in a cylindrical compact.

## 1.5 Program Description

Achievement of the program goals will consist of activities related to kernel fabrication, coating, compacting, irradiation and accident testing, and fuel performance modeling.

### 1.5.1 Program Scope

The overall scope of the Program includes the following task elements:

*Fuel Manufacture*—This task element produces coated-particle fuel that meets fuel performance specifications and includes process development for kernels, coatings, and compacting; quality control (QC) methods development; coater scale-up design and development; and process documentation needed for technology transfer. This effort will produce fuel and material samples for characterization,

irradiation, and accident testing as necessary to meet the overall goals. The plan also identifies work to develop automated fuel fabrication technologies suitable for mass production of coated-particle fuel at an acceptable cost.

Automated fuel fabrication technologies developed during the R&D activities will be transferred to one or more commercial entities.

*Fuel and Materials Irradiation*—This task element will provide data on fuel performance under irradiation as necessary to support fuel process development, to qualify fuel for normal operation conditions, and to support development and validation of fuel performance and fission product transport models and codes. It will also provide irradiated fuel and materials as necessary for PIE and safety testing. A total of eight irradiation experiments have been planned to provide the necessary data and sample materials.

*Safety Testing and PIE*—This task element will provide the equipment and processes to measure the performance of AGR fuel under accident conditions. This work will support the fuel manufacture effort by providing feedback on the accident-related performance of kernels, coatings, and compacts. Data from PIE and accident testing will supplement the in-reactor measurements [primarily fission gas release-to-birth (R/B)] as necessary to demonstrate compliance with fuel performance requirements and support the development and validation of computer codes.

*Fuel Performance Modeling*—This task element addresses the structural, thermal, and chemical processes that can lead to coated-particle failures. Modeling activities will address the release of fission products from the fuel particle, including the consideration of the effect of fission product chemical interactions with the coatings, which can lead to degradation of the coated-particle properties. Computer codes and models will be further developed and validated as necessary to support fuel fabrication process development. Results of these modeling activities will be essential to the plant designer in establishing the core design and operation limits, and demonstrating to the licensing authority that the applicant has a thorough understanding of the in-service behavior of the fuel system.

*Fission Product Transport and Source Term*—This task element will address the transport of fission products produced within the coated particles and the fuel element to provide a technical basis for source terms for AGRs under normal and accident conditions. The technical basis will be codified in design methods (computer models) validated by experimental data. This information will provide the primary source term data needed for licensing.

### 1.5.2 Program Completion

The Program will be considered complete when the physical work is complete, all program Facility Change Forms (FCFs) and work orders are closed, all charge numbers have been closed, and the final closing cost statement and program completion report have been delivered. The current program completion is expected in 2020.

## 2. MANAGEMENT, ORGANIZATION, AND INTERFACES

The program is operated under the technical direction of the Research and Development (R&D) Technical Director who reports to the DOE-NE AGR Fuel Development and Qualification Program Director. The R&D Technical Director provides a single point of contact for the Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL) and the Technical Coordination Team (see Figure 1).

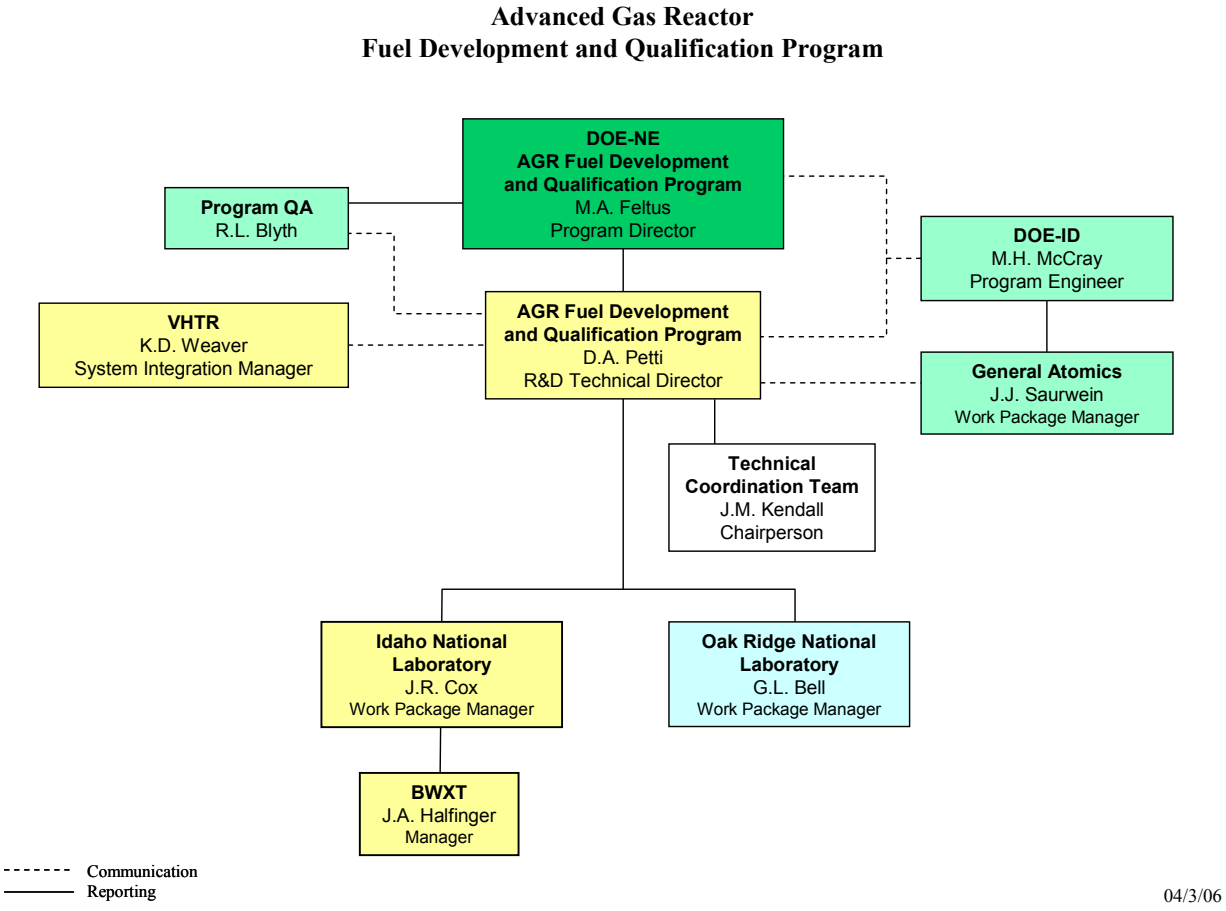


Figure 1. AGR Fuel Development and Qualification Program Organization Chart

The DOE-NE Program Director is responsible and accountable for project management activities at the federal level, and serves as the single point of contact for the R&D Technical Director.

The R&D Technical Director is the technical interface between INL, ORNL, DOE-NE, and DOE-ID AGR participants. He provides general project oversight on program strategy, requirements, issue resolution, scope, schedule, budgets, performance, and reporting. He is responsible for review and approval of work packages and program planning documents (Annual Implementation Plan, Quality Program Plans, Technical Program Plan, etc.), and assuring that progress is consistent with the AGR Technical Program Plan,. In addition, the R&D Technical Director is responsible for timely resolution of issues, and notification to DOE-NE on outstanding issues that require higher level attention.

The VHTR System Integration Manager is responsible to provide the detailed VHTR reactor design, including in-service fuel requirements.

The DOE-ID Program Engineer is responsible for providing support to the DOE-NE Program Director, oversight of the INL contractor and oversight of the General Atomics subcontractor.

The DOE-NE Quality Assurance Specialist is responsible to evaluate site-specific QA Plans to ensure compliance with applicable requirements. He is also responsible to perform periodic audits and surveillances to determine effective implementation of those QA programs.

The Technical Coordination Team serves as a forum for exchange and review of technical information relevant to technical issues and decisions affecting multiple Program participants, and will make nonbinding recommendations to the R&D Technical Director on resolution of the topics addressed, as appropriate.

Work Package Managers are responsible for project execution including development and implementation of site-specific work packages and performance metrics, and comprehensive input to the integrated schedule that further defines the authorized scope. These individuals are also responsible for development and implementation of effective quality assurance programs, and the supervision of technical leads and other subordinates as necessary to accomplish the program mission within the approved cost and schedule. Issues that can not be resolved are elevated to the R&D Technical Director.

The organizational reporting structure of the INL Program team is shown in Figure 2. Responsibilities of the R&D Technical Director (TD), the Program Execution Manager (EM), and Task Technical Leads are discussed in the following section.

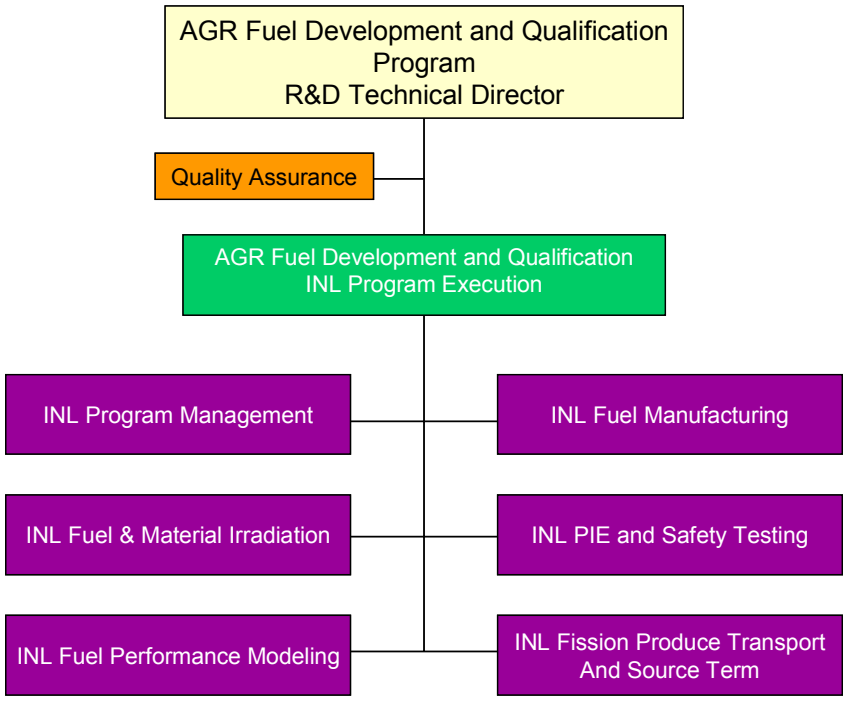


Figure 2: INL Organization Down to the Advanced Gas Reactor Program.

## 2.1 Responsibilities and Authorities

This section describes the program participants, relationships, interfaces, lines of authority, and accountability specific to this program.

### 2.1.1 AGR Fuel Development and Qualification Program R&D Technical Director

The INL AGR Fuel Development and Qualification Program R&D technical director (TD) is responsible to oversee the INL activities associated with program management, fuel manufacturing, irradiation, post-irradiation examination, fuel performance modeling, and analysis of fission product transport and source term. The director's end goal is a qualified coated-particle that satisfies the fuel requirements of the NGNP design given by the NGNP/VHTR System Integration Manager from the reactor design team.

The TD is responsible for:

- Interfacing with the DOE-NE Program Director, DOE-ID managers and staff, Battelle Energy Alliance (BEA) senior management, and the Technical Coordination Team.
- Communicating with the VHTR System Integration Manager concerning fuel requirements
- Coordinating activities of INL and ORNL participants
- Obtaining funding for Program activities
- Organization and direction of the AGR Fuel Development and Qualification Program.

### 2.1.2 INL Program Execution Manager

The INL Program Execution Manager (EM) is responsible for organization and execution of the program. Primary EM responsibilities include:

- Ensuring adherence to DOE Order O 413.3, *Project Management for the Acquisition of Capital Assets*.
- Ensure that subcontracts contain provisions appropriate to the contract type and comply with Federal Acquisition Regulations and DOE Acquisition Regulations
- Work Planning
  - Establishing program schedules, milestones and detailed work packages
  - Baseline change proposals
  - Field Work Proposals / Field Task Proposals, Generation IV work package, DOE-NE internal planning package forms, and Annual Implementation Plan
  - Annual priority list
  - Activity-based logic chart
  - Integrated schedules
- Technical Oversight
  - Strategic planning
  - Daily staff coordination and direction
  - Weekly schedule status meetings
  - Review and approval of engineering design file and technical reports
- Performance Reporting
  - Development and implementation of systems to measure and control baseline performance metrics
  - Weekly teleconferences

  - Monthly schedule status input, monthly ANESI status meetings, monthly reports to DOE-NE, monthly reports to PICS, and monthly status teleconference with DOE-NE
  - Quarterly review meetings for DOE-NE, semiannual review meetings for the Advanced Fuel Cycle Initiative (AFCI), and semiannual review meetings for Generation IV
- Administrative Oversight
  - Employee position descriptions, annual performance reviews, and job postings
  - Responses to DOE-NE ad hoc requests
  - Coordination with ORNL project management
- Program Documentation
  - Project Execution Plan, Quality Program Plan, Configuration Management, Records Management, and correspondence control.

### 2.1.3 Task Technical Leads

Each Technical Lead coordinates with the EM in planning and executing all engineering and operations functions. Primary responsibilities of the Technical Leads are:

- Establishing and maintaining a program technical baseline for the assigned task element
- Managing work within the established baseline scope, schedule, and cost
- Obtaining, organizing, and coordinating the resources to perform authorized activities and to resolve engineering and operation issues
- Providing oversight of the day-to-day engineering and operational activities, including monitoring and controlling all subcontracts for materials and services
- Provide technical oversight of subcontracts and enforce subcontractor accountability consistent with subcontract provisions
- Reviewing and concurring with the Technical and Functional Requirements (TFR), related to assigned activities, to ensure that requirements can be met
- Ensuring all documents (drawings, engineering design files, reports, etc.) produced by the team are in compliance with the company standards and entered into the company document management system
- Reporting to the EM work package status periodically (such as weekly, monthly).

### 2.1.4 Program Interfaces

Program personnel may interface directly with other INL organizations on routine matters (e.g., status of activities). All formal interfaces with DOE-ID, DOE-HQ or ORNL participants will be through the AGR Fuel Development and Qualification R&D Technical Director.

## 3. PROGRAM REQUIREMENTS

DOE-ID is the contracting organization and has oversight responsibilities for BEA Contract Number DE-AC07-05ID-14517, which identifies the requirements and work scope applicable to the program.

Project performance criteria are defined in the contract and the annual Program Execution Guidance is provided by DOE. Oversight of the Program is a primary function of DOE-NE and DOE-ID.

AGR fuel development activities are conducted for the Generation IV Program Office. This office initiates requirements for fuel development activities as they relate to program interests.

## 3.1 Operational Requirements

Company operations requirements are outlined in Companywide Manual 9, *Operations* and in Companywide Manual 10A, *Engineering and Research*. Refer to PDD-1004, *Integrated Safety Management System*, for a comprehensive flow of work planning to work activity level requirements.

Conduct of operations as defined in DOE Order 5480.19 and PRD-185, *Conduct of Operations*, is implemented. The 19 elements of this program are fundamental to the manner in which operations are conducted to comply with DOE requirements.

### 3.1.1 Program Performance Objectives

The primary objective of the Program is to provide technically sound, timely, cost-effective planning and execution of the program, in conformance with quality and safety requirements. Worker, public, and environmental safety are a top priority in the INL Program.

The Program performance objectives are derived annually in PLN-1586. The overall objectives include the following work scope objectives:

- Develop and produce a high performance low-enriched uranium oxy-carbide fuel (LEU UCO) in quantities to support the AGR fuel qualification process
- Design experiments and conduct irradiation of experiments on LEU UCO in the Advanced Test Reactor at the INL to gather data on fuel performance
- Develop the process and system to perform post irradiation examination of the AGR experiments to gather data for qualifying LEU UCO
- Safety testing to measure the performance of AGR fuel under normal and accident conditions.
- Develop the fuel performance modeling codes to support the licensing of the AGR fuel
- Develop the fission product and source term codes to support licensing of the AGR fuel

## 3.2 Resource Requirements

Annual planning, which includes resource-loaded schedules and resource leveling, identifies the resource requirements for the Program. The project controls system will track and report schedule and cost variances.

Technical support to complete the assigned work scope is obtained through the use of a matrix structure from various Home Organizations. In addition, technical leads must determine what interfacing functions/organizations such as Packaging & Transportation, Construction, Health Physics, Operations, Maintenance, Engineering, Infrastructure, and Technology Development are necessary to provide resources according to plans and BEA requirements.

### 3.2.1 Personnel Training and Qualifications

Program personnel must have a current Employee Position Description, verified evidence of education and experience for applicable positions, and documented indoctrination and training tailored for the work being performed, per requirements in PRD-5072, *Personnel Training and Qualification*. A program-specific training plan is in development to ensure that additional program specific documents are understood and followed.

# 4. PROGRAM PERFORMANCE BASELINE

## 4.1 FY 2006 Performance Measures

The FY-06 performance measures for the overall Program are provided in annual Program Execution Guidance letters from DOE-NE and reiterated below for FY-06. The FY-06 workscope is focused on completing preparations to insert the AGR-1 experiment into the Advanced Test Reactor (ATR). This first AGR experiment test train will be placed in the ATR reactor in early FY-07.

- Complete the fabrication of baseline TRISO coated particles for the fuel shakedown irradiation (AGR-1) experiment.
- Complete the fabrication of variant TRISO coated particles for the fuel shakedown irradiation (AGR1) experiment.
- Complete fabrication of baseline and variant fuel compacts for the fuel shakedown irradiation (AGR1) experiment.
- Complete the Advanced Test Reactor (ATR) 2C Cubicle modifications, and the Gas Control System and Fission Product Monitor Installations.
- Complete the fuel shakedown irradiation (AGR-1) experiment test train fabrication and assembly, and all other activities necessary to insert the experiment into the Advanced Test Reactor (ATR).
- Enhance computer model and simulation codes for fuel performance modeling. Perform computer code benchmarks for fuel performance models, and develop improved accident codes.
- Update the fuel shakedown irradiation (AGR-1) experiment pretest prediction using actual fuel characterization data along with the most current physics and thermal evaluations of the test.
- Complete fabrication of LEU UCO kernels for AGR-3 & 4 designed-to-fail particles.

### 4.1.1 Key Assumptions

Life cycle planning basis includes documented requirements and assumptions, work scope definition, schedule considerations, and cost estimates. Life cycle baseline (LCB) planning for the AGR Fuel Development and Qualification Program will not start until this program is designated as a funded line item project. It is assumed that, until that time, detailed work planning will be done on an annual basis as described in Section 4.2 below. PLN-1586, *Advanced Gas Reactor Fuel Development and Qualification*

*Project FY-05 Annual Implementation Plan,* establishes the organizational structure, approved work scope, work breakdown structure (WBS), funding allocations, requirements, deliverables, and milestones for FY-06. The Plan will be updated each year until the planned developmental activities become a line item project.

## 4.2 Annual Work Planning

Each year in mid-summer, preliminary draft funding guidance for the following fiscal year is provided by DOE-NE. Based on this guidance and the Technical Program Plan, the R&D Technical Director develops an annual Priority List and assigns scope and an estimated budget to primary program participants. Each primary program participant then develops a draft Generation IV Work Package through the PICS system to identify major activities, milestones, deliverables, and assumptions. Consistent with the agreed upon budget and associated scope, DOE-NE issues an annual Program Execution Guidance letter to DOE-ID authorizing the funding to be released. Typically, the initial Guidance Letter addresses only the period of Continuing Resolution until Congress and the Administration formally approve the annual funding. Work planning then becomes an iterative process until the baseline contained in the Generation IV Work Package is formally submitted and approved by DOE-NE in the PICS system.

The major activities, milestones, and deliverables are defined in INL internal work packages and associated bases of estimates (BOEs) and schedules. Pertinent information contained in the INL work packages is used in the development of DOE-NE Internal Planning Package Forms. In coordination with the other program participants, the Generation IV Work Package and Internal Planning Package forms are inserted into the Annual Implementation Plan, PLN-1586.

# 5. PROGRAM CONTROLS

## 5.1 Baselines and Baseline Change Control

The Program baseline is updated during annual planning. As the scope, cost, or schedule mature during the execution year, baseline change proposals (BCPs) may be required to adjust the baseline to reflect significant deviations from the original plan. The baseline is formally changed upon approval of a BCP. Therefore, the current baseline is the beginning of the year baseline plus all approved baseline change proposals.

The baseline is established by a detailed work planning process that is tracked in the Cobra system for costs and in Primavera P3 for schedule.

## 5.2 Work Authorization

The execution manager (EM) is authorized to execute the work scope identified in the approved periodic Program Guidance Letters and the accompanying Work Authorization System forms. The EM, working with the planning and controls engineer, establishes charge numbers for tracking the cost of program activities. The EM has overall authority to authorize work on the program.

## 5.3 Performance Measurement

The program baselines establish the core elements and activities required to measure performance and control the program. Performance measurement will be conducted in accordance with management control procedure MCP-3822, *Performance Measurement, Analysis, Estimates at Completion, and Reporting*.

Throughout the fiscal year, the baseline for scope, budget, and schedule is controlled and monitored through a system of performance metrics to ensure that the approved scope is completed on time and within budget. Each month, technical leads status all scheduled activities to identify the percentage completion for each activity. This information is entered into the financial system, and the Budgeted Cost of Work Performed (BCWP) is calculated. The BCWP value is compared to the Budgeted Cost of Work Scheduled (BCWS) to determine schedule variance. Further, the Actual Cost of Work Performed (ACWP) is compared to the BCWP to determine the cost variance.

During each monthly reporting period, the EM is responsible for evaluating cost and schedule status for in-process work in terms of physical percentage complete against the baseline. The cumulative variances for cost and schedule (individually) may not vary more than plus or minus 10% from the baseline without a detailed explanation and corrective action plan. EM along with the WPM must recognize, develop, and implement corrective actions quickly to keep the program within the budget and schedule limits.

Another important performance metric is the Estimate at Completion (EAC). Beginning each April and followed monthly thereafter, technical leads prepare a detailed EAC analysis to evaluate the remaining scope and funding for each task level by establishing an Estimate to Complete (ETC). The EAC is the sum of cumulative actual costs plus the ETC. For each task level, the EAC is compared to the budget and adjustments or corrective actions are implemented accordingly.

## 5.4 Reporting

The program reporting requirements are derived from the needs and requirements of the various organizations that provide funding or interface such that reporting is required for the Program. Some reports are oral; some are written. Others are in a presentation form, each depending on the target audience. The list below contains the various reports required by the program and frequency of the report.

- Weekly teleconferences with Program participates and DOE-HQ and DOE-ID to discuss the schedule punchlist
- Monthly schedule status input to the INL DWP financial system
- Monthly ANESI status meeting
- Monthly reports to DOE-NE
- Monthly reports entered in the Performance Information Collection System (PICS) program operated by Performance Results Corporation (PRC)
- Monthly Status Teleconference with PRC
- Quarterly Review Meetings for DOE-NE.

The monthly program report for DOE-NE will be issued in accordance with a template specified by the R&D Technical Director. Other reporting requirements may be placed on the program from the customer or management as needs for specific reports are identified.

## 5.5 Non-Disclosure Agreements

Non-disclosure agreements shall be negotiated and signed between major contributors to the AGR Program to protect intellectual property on all sides. The intent of the agreements is to protect intellectual property on all sides from unauthorized use or unauthorized or accidental disclosure. Under this agreement, proprietary and business sensitive information shall be identified by an appropriate and conspicuous marking and appropriately controlled.

## 5.6 Program Access by Foreign Nationals

Foreign national access to the INL for purposes of work or visits shall be reviewed and approved in accordance with MCP-296, *Processing and Approval of Foreign National Access*. The process outlined in this MCP applies to any employee who will be a foreign national host or will review, process, or approve a request for a foreign national visitor, assignee, or employment candidate.

# 6. CHANGE MANAGEMENT

Baseline change control of scope (technical), cost, and schedule for the program will be conducted in accordance with MCP-3416, *Baseline Change Control*. Configuration management (CM) must follow the process outlined below. Any scope or schedule change that revises the basis of the work (i.e., revised technical approach, additions or deletions of work or changes in the assumed conditions) will be a candidate for the BCP. As changes in scope are identified, they are brought to the attention of the EM before work is started. The EM will be responsible to bring these changes to the attention of senior management and the customer for review and approval via the BCP process.

# 7. ENGINEERING/TECHNICAL

Designs will be performed by in-house and subcontracted engineering services as appropriate. Design control, configuration control, and configuration management will be implemented as described below.

## 7.1 Design and Configuration Control

Design control and configuration management requirements are outlined in Companywide Manual 10A, *Engineering and Research*.

The functions of CM are grouped into the following basic CM life-cycle elements

1. Design requirements element. The objective of this element is to establish and maintain the design requirements and the associated design basis.

2. Document control element. The objective of this element is to identify and maintain documents within the CM Program consistent with the physical configuration and design requirements.

3. Change control element. The objective of this element is to maintain consistency among the design requirements, the physical configuration, and the documentation as changes are made.

## 7.2 Configuration Management

Effective CM is obtained by following requirements, which provide for (1) consistent identification of items requiring configuration control, (2) management of requirements and documentation applicable to the items, and (3) control of changes to the items.

The Program will create and maintain a list of essential systems, including equipment and software that that will require configuration control during the lifetime of the Program. The list of essential systems will be documented in an Engineering Design File.

The Program will maintain configuration management on all of its systems and test assemblies directly associated with testing the AGR fuel by following existing company procedures. Essential systems will be maintained using the following company procedures:

| | |
|---|---|
| Design Control | MCP-2374, *Analysis and Calculation*<br>MCP-2811, *Facility Engineering Change*<br>MCP-9185, *Technical and Functional Requirements*<br>MCP-3056, *Test Control*<br>MCP-9217, *Design Verification* |
| Document Control | LWP-1201, *Creating, Modifying, and Canceling Procedures and Other DMCS-Controlled Documents*<br>MCP-2374, *Analyses and Calculations*<br>MCP-2875, *Maintaining Laboratory Notebooks* |
| Software | MCP-550, *Software Management*<br>MCP-2374, *Analyses and Calculations*<br>MCP-3039, *Analysis Software Control*<br>MCP-3630, *I&C Computer System Management* |
| Quality Assurance Records | LWP-1202, *Records Management*<br>PLN-1948, *Records Management Plan for the Advanced Gas Reactor Fuel Development and Qualification Program* |

# 8. ACQUISITION STRATEGY

Since AGR is an R&D program rather than a construction-type project, an acquisition execution plan is not considered applicable. The majority of the work will be done by M&O contractor personnel (INL and ORNL) and by a single subcontract with BWXT for fuel fabrication. Any required modifications of

government facilities will be done by sub-contractors, M&O contractor personnel, or construction force account personnel, according to the Davis-Bacon determination for the work.

# 9. PROCUREMENT

Procurement of services or goods for the program will be in accordance with MCP-1185, *Acquisition of Materials and Services*. A combination of fixed-priced and fixed-rate, ceiling-priced subcontracts will be utilized to procure services and materials from external sources. Acquisitions will be controlled to ensure that procured items and services meet specified requirements. Procurement activities will also conform to the requirements of the program's quality program plan (QPP), PLN-1468, and MCP-3491, *Acceptance of Procured Items and Services*.

# 10. RISK ASSESSMENT AND MANAGEMENT

Risk is defined as a quantifiable expression of the probability and consequences that an event will prevent the program from meeting its defined program baseline. Risk includes a variety of categories, such as technology, schedule, budget, safety, and regulatory. Due to the R&D nature of the project, management personnel are continually keyed on technology, schedule, and budget risks as a normal part of their oversight job. Program progress and schedule are reviewed weekly with DOE-HQ, INL, and ORNL program personnel.

The nuclear nature of the project invokes the requirement for safety analysis (in compliance with 10 CFR 830) and formal operational procedures for the operations activities associated with the project, such as ATR reactor and hot cell operations. MCP-1176*, Safety Analysis Process*, implements the INL safety analysis process to create the required safety basis documents for work activities. Hazards and regulatory compliance are routinely evaluated and mitigated by these required activities. All commercial shipments will be made in full compliance with Department of Transportation (DOT) regulations.

## 10.1 Performance Indicators

Progress is reported for on-going AGR Fuel Development and Qualification Program activities as described in Section 5.4.

## 10.2 Process Control Methods and Requirements

Process control methods are prescribed by technical procedures for those activities, requiring continuous monitoring at INL facilities. Operations, criticality, and radiological controls are the areas most often associated with technical procedures. However, other controls to provide negative or positive pressure boundaries, control water temperature, chemistry, or level are used at INL. The safety analysis reports identify the hazards and the procedural or equipment controls necessary for safe operation.

# 11. ES&H, QUALITY, AND SECURITY

## 11.1 Environmental, Safety, and Health

Company environment and health requirements are outlined in Companywide Manual 8, *Environmental Protection and Compliance*.

INL uses the Integrated Safety Management System (ISMS) established in PDD-1004, *Integrated Safety Management System*, to prescribe the procedures and processes necessary to do work safely. The fundamental premise of the ISMS is to "Perform Work Safely." This is achieved by implementing formal processes that provide rigor and discipline to work execution. The ISMS uses a top-down process for performing work and the associated requirements at each level. The framework for the ISMS is organized around the following five core functions: (1) define the work, (2) identify and analyze the hazards, (3) develop and implement controls, (4) perform the work, and (5) provide feedback for improvement.

All operations and maintenance work will be performed according to the approved company policies and procedures for radiation protection, industrial hygiene, and industrial safety.

### 11.1.1 Radiation Protection

Company radiation protection requirements are outlined in the following Companywide Manuals:

- Manual 15A, *Radiation Protection INEL Radiological Control*
- Manual 15B, *Radiation Protection Procedures*
- Manual 15C, *Radiological Control Procedures.*

### 11.1.2 National Environmental Protection Act

Environmental checklists will be completed in accordance with MCP-3480, *Environmental Instructions for Facilities, Processes, Materials and Equipment*, as required for program activities.

### 11.1.3 Stop Work/Integrated Safety Management System/Voluntary Protection Program

This program supports each employee's stop work authority and voluntary protection program bill of rights. Any team member (including subcontract personnel) has the responsibility and authority to initiate stop work for any environmental, safety, or quality issue. In addition to reporting the issue to the cognizant authority, the EM must also be notified.

It is each team member's responsibility to think in terms of safety as work documents are reviewed and input provided. Each team member is encouraged to contribute to the safety of the program by participating with safety shares at all meetings.

## 11.2 Safeguards and Security

Safeguards requirements are imposed to maintain accountability of fissile material. All activities involving fissile material accountability will be reviewed and approved by Safeguards and Security personnel in accordance with Manual 11D, *Safeguards and Security Nuclear Materials Control and Accountability,* and MCP-2752, *Shipments and Receipts of Nuclear Material*, as appropriate.

Safeguards and security requirements that must be met by the Program are outlined in the following Companywide Manuals:

- Manual 11A, *Safeguards and Security - Program Management*
- Manual 11B, *Safeguards and Security - Protection Program Operations*
- Manual 11C, *Safeguards and Security - Information Security*
- Manual 11D, *Safeguards and Security - Nuclear Materials Control & Accountability*
- Manual 11E, *Safeguards and Security - Personnel Security*.

### 11.2.1 Classified and Sensitive Unclassified Information Identification and Control

MCP-2809, *Preparation, Handling, and Review of Technical Information Technical Products*, gives direction for reviewing technical information and imposes the following requirement :

> "If the information contains classified or sensitive unclassified information or if there is any uncertainty as to whether it does, then discuss the information with an Authorized Derivative Classifier associated with the program or project as early as possible in the preparation process."

MCP-291, *Classified Matter Protection and Control*, identifies protection and control requirements for classified information.

## 11.3 Quality Assurance

All quality-affecting work done for the Program will be done in accordance with the DOE quality assurance (QA) requirements specified in the following documents:

- DOE Order O 414.1C, *Quality Assurance*
- DOE-NE, *Quality Assurance Requirements and Interface Description (QARI) for the Advanced Gas Reactor Fuel Development and Qualification Program*

The INL QA program is identified in Companywide Manual 13A, *Quality and Requirements Management Program Documents*. The Quality Program Plan (QPP) for the AGR Fuel Development and Qualification Program is PLN-1468, *Quality Program Plan, AGR Fuel Development and Qualification Program*. This QPP establishes the ASME NQA-1 requirements matrix by identifying (1) where the NQA-1 requirements are directly addressed and (2) where the NQA-1 requirements are not applicable based on scope of work.

### 11.3.1 Management and Independent Assessments

Management and independent assessments are conducted to determine the adequacy, effectiveness, and level of implementation of the QA program and identify obstacles to meeting objectives. Management assessments include QA program verifications that are conducted by an independent QA organization to evaluate the scope, status, adequacy, programmatic compliance, and implementation effectiveness of the QA program.

DOE and the M&O contractor at the INL conduct internal and external audits in areas where reasonable cause indicates a need to review practices usually in association with performance or safety issues.

### 11.3.2 Corrective Action

The identification, documentation, tracking, and resolution of conditions adverse to quality are the cornerstone of any quality improvement effort within a QA program. MCP-598, *Corrective Action System*, is the implementing procedure for the AGR Fuel Development and Qualification Program that governs the documentation and resolution of conditions adverse to quality. This procedure defines conditions adverse to quality and significant conditions adverse to quality. MCP-598 contains the steps taken to develop a corrective action plan responsive to the specific deficiencies identified in the condition adverse to quality. Also contained in this procedure are the steps necessary for corrective action verification and closeout.

### 11.3.3 Records Management

PLN-1948, *Records Management Plan for the Advanced Gas Reactor Fuel Development and Qualification Program (AGR)*, is the governing records management plan for managing records created or received by AGR Fuel Development and Qualification Program at INL. Together with LWP-1202, *Records Management*, this plan directs the records management activities of the Program at INL. The Records Management Program is an element of an organization's QA program and is subject to internal audit.

## 12. ACCEPTANCE, TURNOVER, AND CLOSE-OUT

All program FCFs, work orders, and technical procedures must be closed out (not just completed) before program closeout can be declared. The program will follow GDE-70, Section V, Project Closeout. The program team will prepare a checklist of closeout activities to be scheduled. The program records will be transferred, by letter, to the Electronic Document Management System as part of program closeout at the completion of the program.

A separate program Final Cost and Program Completion Report that combines and summarizes the costs and completion reports from the AGR Fuel Development and Qualification Program will be prepared. This report will briefly describe significant accomplishments and lessons learned. A roadmap documenting the distribution of program files will also be provided.