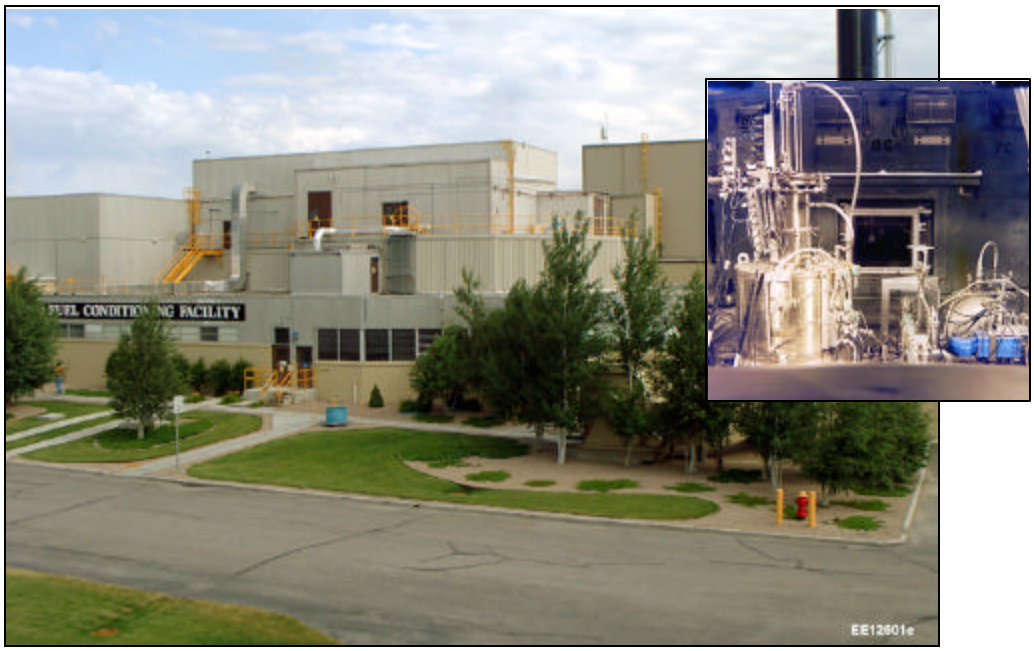
Fuel Cycle Facility (FCF)

Argonne National Laboratory-West



Facility Classification Essential Program Mission Facility

NE Programs to be Supported AFCI and perhaps Gen IV

The Fuel Cycle Facility (FCF) is expected to be used for treatment of Na-bonded EBR-II spent fuel, in accordance with agreements between the DOE and the State of Idaho, and for development and engineering-scale demonstration of pyroprocess unit operations and integrated operations.

Current Capabilities The FCF is located at the ANL-W site near Idaho Falls, Idaho. FCF is a Hazard Category 2 Nuclear Facility that has two large, heavily shielded hot cells, one donut shaped with an argon atmosphere and the other is rectangular shaped with an air atmosphere. The argon cell is an annular, 16-sided polygon that is completely lined with a seal-welded steel liner, and in its center is a central observation room. The argon cell has 15 work stations around the outer periphery of the annulus and 4 inside the central observation room, each with a 5-ft thick window of oil-filled, cerium-stabilized glass and a pair of remote manipulators. Two 5-ton overhead cranes and four 750-lb. electromechanical manipulator can access all locations in the argon cell. The air cell has eight windowed workstations, a 5-ton crane, and two 750-lb. electromechanical manipulators A common wall separates the two cells, and a divided operating corridor extends around both cells. Cell exhaust passes through 2 stages of HEPA filtration. A large mock-up area, used for testing and checkout of equipment prior to installation in the cells, is in the north side of the facility.

A hot repair area is located in the basement and has provisions for hot water spray decontamination of cell components and a suited entry repair area for hands-on work and work through shielded and unshielded glove walls. Radioactive materials are introduced into the air cell via a shielded cask on a 20-ton transfer cart which accesses the cell through an under-cell transfer tunnel. The high bay of the facility building is equipped with a 20-ton bridge crane.

Equipment currently operating in the hot cell includes fuel rod chopping equipment, two electrorefiners, a cathode processor (for distillation of salt and cadmium from cathode product deposits), and an induction furnace for preparing uranium product ingots.

Support facilities that are critical to FCF operation include the ANL-West Analytical Laboratory, the ANL-West Radioactive Liquid Waste Treatment Facility, the Mock-up Shop located inside the Fuel Conditioning Facility, and the Radioactive Scrap and Waste Facility. Other support facilities include the ANL-West Plant Services complex and Machine Shop, and administration spaces. Other facilities that may be required to support the activities served by the FCF include the Electron Microscopy Laboratory and the Alpha Gamma Hot Cell Facility.

Facility Usage FCF is currently used for electrometallurgical treatment of EBR-II spent fuel. However, plans are being prepared to introduce additional equipment into the hot cell that would allow development of technology to remove TRU elements from the electrorefiner salt, as part of an AFCI R&D task. ANL proposes to continue operation of FCF and the electrometallurgical process to complete treatment of EBR-II spent fuel, with concurrent development and demonstration of advanced recycle technologies. Support of the latter mission will likely require installation of additional process into the hot cell, but that can probably be accommodated with the ongoing electrometallurgical treatment operation.

Uniqueness Description FCF is the only hot cell in the DOE complex with operating pyroprocess equipment. The hot cell itself is unique in that the annular shape accommodates cyclic operations, such as a fuel recycle process, and in that it is filled with an inert gas. The Russian Institute of Atomic Reactors (RIAR), near Dmitrovgrad has an operating hot cell with a similar pyroprocess that is used for recycle of spent of mixed-oxide fuel.

Facility Condition The facility was activated in 1963 and from 1964 to 1968 was used for reprocessing of irradiated fuel from the EBR-II reactor. In 1969 the facility was refitted for examination of irradiated fuel experiments from EBR-II. The air cell was again shutdown in 1976-77, extensively refurbished and returned to service. The argon cell was shutdown in 1977 and decontaminated in 1980. Cranes, electromechanical manipulators (EMMs), remote mechanical manipulators and windows were refurbished through 1981. Argon cell refurbishment to support electrometallurgical treatment operations was completed in 1995. Electrometallurgical treatment with irradiated fuel commenced June 6, 1996. There is no current disposition plan for the facility.

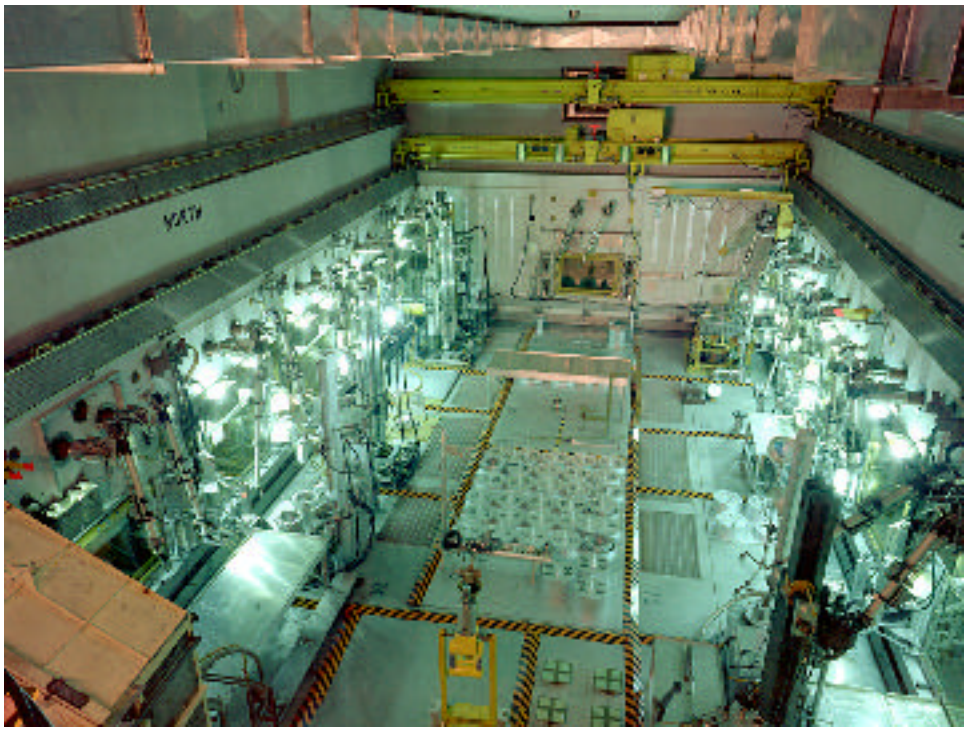
Facility Employment and Costs

FCF	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	55.2	9.8	55.2	9.8
Mission-Capable	(10.1)	1.7	10.1	1.7
Program Execution	20	3.3	32	5.3
Total Annual Operations	85.3	14.8	97.3	16.8
One-time deferred maintenance[4]		(3.6M)		
Anticipated one-time cost to prepare facility for anticipated programs[5]				TBD

1. Readiness level FTEs and costs includes infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission"** Capable provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution"** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. Preparation for future activities is envisioned to include design, fabrication, and installation of new process equipment, the cost of which remains to be determined.

Hot Fuel Examination Facility (HFEF)

Argonne National Laboratory-West



Facility Classification Essential Program Mission Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, other programs that would require remote examination and characterization of radioactive materials.

The Hot Fuel Examination Facility (HFEF) is projected to be used for remote examination and characterization of irradiated fuels and materials in support of any of the anticipated DOE-NE missions. Examinations will likely include non-destructive examination, such as dimensional measurements and neutron radiography, and destructive examination, such as mechanical testing or metallographic/ceramographic characterization. Other projected support of irradiation testing includes loading and unloading of test loops used in conjunction with the Advanced Test Reactor (ATR) or the Transient Reactor Test Facility (TREAT). In addition, fuel treatment and recycle activities will be supported in HFEF for activities such as unit process development and demonstration and engineering-scale demonstration of recycle processes.

Current Capabilities HFEF is located at the ANL-W site near Idaho Falls, Idaho. HFEF is a Hazard Category 2 Nuclear Facility that provides shielding and containment for remote examination, processing, and handling of highly-radioactive, TRU-bearing materials. Historically, the equipment was designed primarily to address fuel rods and assemblies, but recent additions such as ceramic waste processing equipment indicate that the hot cell has broader capabilities. A recent modification to the facility now allows

receipt of almost any over-the-road commercial shipping cask (with appropriate interface rings and fixturing) and examination of full-length LWR fuel assemblies and rods.

The hot cell was completed in 1974 and has since had no major modifications. The facility has two large, highly-shielded hot cells. The main cell, which is stainless steel-lined and gas tight, measures 70-ft long by 30-ft wide by 25-ft high and is filled with high-purity - argon. The decontamination (decon) cell, which is air filled, measures 20-ft long by 30-ft wide by 25-ft high.

The main cell has 15 work stations, each with a 4-ft thick window of oil-filled, cerium-stabilized glass and a pair of remote manipulators. The decon cell has six similarly-equipped workstations. Each cell is equipped with overhead cranes and overhead electromechanical manipulators. Cell exhaust passes through at least 2 stages of HEPA filtration (some locations, such as the metallography containment box have separate exhaust outlets with additional filtration).

Radioactive materials are introduced into the hot cells via a shielded cask, including commercial shipping casks up to 28 tons in weight, on a transfer cart which accesses the cells through an under-cell transfer tunnel. A penetration through the top of the main cell also allows the introduction of large components or fuel assemblies; large sodium test loops have been inserted into the cell through this penetration. The Waste Characterization Area is a Pu-containment glovebox that sits in an enclosed facility above the main cell.

The HFEF also houses the Neutron Radiography Reactor (NRAD), which is a 250 kW TRIGA reactor. NRAD's main function is to provide neutrons for neutron radiography of irradiated components. It is equipped with two beam tubes and two separate radiography stations making it one of the finest facilities in the world for radiography of irradiated components. The first NRAD radiography station is located within the argon-filled hot cell and provides the ability to neutron radiograph highly irradiated fuel elements, fuel subassemblies, loop experiments, or waste cans without removing them from the main cell's argon atmosphere. The second neutron radiography station is located outside of the main cell and permits neutron radiography of either unirradiated or irradiated specimens without introducing them into the contaminated main cell.

In addition to normal radiography operations, the NRAD facility has been used for research in advanced neutron radiography techniques, including fast neutron radiography used for measurement of plutonium content in spent fuel assemblies. NRAD also has some in-core irradiation capabilities, consisting of a water-filled tube at the center of the core (approximately 4 cm diameter), and a dry tube (up to 10 cm diameter) at the edge of the core. Additionally, the two beam rooms have been used for advanced neutron detector development, and measurement of fundamental parameters for fission fragment induced fluorescence. The NRAD facility also houses an MF Physics linear particle accelerator, which is currently used for non-destructive assaying of waste and expended nuclear fuel.

Significant projects that have been performed in HFEF include 1) examination of fuels and components for the Liquid Metal Fast Breeder Reactor (LMFBR) and Integral Fast Reactor (IFR) programs, 2) preparation and post-test examination of tests utilizing large test loops for irradiation in the Transient Reactor Test Facility (TREAT) and the Sodium Loop Safety Facility (SLSF), 3) examination of test assemblies and fuel rods irradiated in the Fast Flux Test Facility (FFTF).

Support facilities that are critical to HFEF operation include the ANL-West Analytical Laboratory, the ANL-West Radioactive Liquid Waste Treatment Facility, the Mock-up Shop located inside the Fuel Conditioning Facility, and the Radioactive Scrap and Waste Facility. Other support facilities include the ANL-West Plant Services complex and Machine Shop, and administration spaces. Other facilities that may be required to support the activities served by the HFEF include the Electron Microscopy Laboratory, the Alpha Gamma Hot Cell Facility, the Advanced Test Reactor, and TREAT.

Facility Usage The inert atmosphere main cell (hot cell) of the facility is currently being used to support development of the ceramic and metal waste forms associated with the DOE-NE spent fuel treatment program. The hot cell can also be used to support non-destructive examination of spent fuel and other radioactive materials; however, there are currently only small, short term contracts for these activities. The hot cell is currently operating at less than 50% of its capacity on a 40 hr/wk basis in its support of spent fuel treatment activities. The current spent fuel treatment activities are similar to and compatible with the activities envisioned for the Advanced Fuel Cycle initiative and there is more than sufficient capacity to support both programs in the hot cell. The waste characterization area, which is physically separate from the hot cell, has been used to support DOE-EM characterization of TRU waste. It is anticipated that some DOE-EM waste characterization activities will continue in the facility for an extended period of time. However, the waste characterization program activities have minimal impact on hot cell activities. Work-for-others types of activities are generally short term contracts and are always subordinate to the major NE programs.

Uniqueness Description HFEF is one of many currently operating hot cells in the DOE complex. However, HFEF is the only large, inert atmosphere hot cell that is suitable for examination of chemically reactive materials (e.g., the sodium-bonded metallic fuels that have been examined there historically, but also other materials such as mixed carbide and nitride fuels). Similar facilities exist internationally (although the extent to which HFEF capabilities are duplicated is not clear) and are used by other nations for fuels and materials examination. Historical operation of programs in EBR-II and FFTF that made use of HFEF support have indicated the advantages to near-by and/or domestic operation of mission essential facilities. Cost advantages are difficult to quantify, because additional costs associated with use of foreign facilities is typically incurred in intangible ways, such as the schedule delays over which the U.S. has no control and the additional burden of information exchange to support a program in a foreign facility.

Facility Condition HFEF construction was completed in 1974, and its original mission was to examine fuel assemblies and components irradiated in EBR-II and in the FFTF.

The facility is currently in full operation with the bulk of its original capability intact. However, accommodation of anticipated program activity requires that the fuel examination equipment be updated and reconfigured. The safety authorization basis for the facility is current and complete for the anticipated missions. The NEPA and air permitting status is current, and anticipated activities should be allowed under that status; however, HFEF operations should be addressed in any larger, programmatic NEPA activity that addresses future NE programs. There is no current disposition plan for the facility.

Facility Employment and Costs

HFEF	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	32	5.6	32	5.6
Mission-Capable	(11.5)	(2.1)	(15)	(2.8)
Program Execution	30	5.1	40	6.8
Total Annual Operations	73.5	12.8M	87	15.2M
One-time deferred maintenance[4]		(2.6M)		
Anticipated one-time cost to prepare facility for anticipated programs[5]				15M – 25M over several years

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission Capable"** provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution"** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs" are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. Reflects estimated one-time costs to update HFEF fuel examination equipment and to re-establish station and fixtures for test loop handling.

Fuel Manufacturing Facility (FMF)

Argonne National Laboratory-West

Facility Classification Essential Program Mission Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, and other programs that would require fabrication and characterization of TRU-bearing materials or CAT-I quantities of special nuclear materials.

The Fuel Manufacturing Facility (FMF) is expected to be used for fabricating and characterizing test fuels that will be tested in the ATR and TREAT. Other activities include measuring properties of TRU-bearing waste surrogates and management of portions of the ANL-W special nuclear materials inventory.

Current Capabilities The Fuel Manufacturing Facility (FMF) is located at the ANL-W site near Idaho Falls, Idaho, adjacent to the Zero Power Physics Reactor. The building is A Hazard Category 2 Nuclear Facility and is secured inside the ANL-W CAT-I Protected Area and is buried under an earthen mound. For much of the operating life of the Experimental Breeder Reactor-II (EBR-II), all its fuel was manufactured in FMF. The facility was completed in 1986 and was comfortably oversized for the EBR-II fuel mission.

The building consists of a support area that is not covered by the earthen mound and an operating area, which is divided into a north room, south room, and special nuclear materials vault. Equipment in the building includes an induction furnace configured for injection casting, glove boxes with instruments for measuring thermophysical properties of TRU-bearing materials, glove boxes for R&D-scale fabrication of TRU-bearing fuels and materials, and a radiography room.

Facilities that support FMF operations include the ANL-West Analytical Laboratory, the Electron Microscopy Laboratory, waste storage and handling facilities, the ANL-West Plant Services complex and Machine Shop, and administration spaces.

Facility Usage The FMF is currently used for uranium processing and handling operations, nuclear material storage, and materials characterization. Many of those activities support the development of electrometallurgical treatment of spent nuclear fuel. These operations occupy some glove box space and make periodic use of the FMF induction furnace and uranium handling glove boxes in the south room of FMF. A current installation activity is preparing glove boxes and equipment in the north room of the facility for fabrication or TRU-bearing fuel samples in support of the Advanced Fuel Cycle Initiative. Operations for the stabilization of hydrided ZPPR highly-enriched uranium (HEU) fuel plates and its subsequent preparation for use as reactor fuel feed material are carried out primarily in the south room, with some interim storage in the FMF vault. The FMF vault is currently used to store part of the ANL-West inventory. The facility is currently operates at less than 50% of its capacity for laboratory-type operations. If the facility were to be converted back to a production-type operation (as was EBR-II fuel manufacturing), then the building could more efficiently accommodate more operational activity. No conflict between current activities and future activities are expected.

Uniqueness Description The FMF is one of an increasingly small number of facilities in the U.S. that have the security and hazard classification necessary to house special nuclear material operations. Such a facility is necessary for fabrication of fuels using operations requiring larger amounts of special nuclear material. Although the FMF was constructed as a uranium processing facility (it did not meet requirements for a plutonium processing facility), subsequent equipment installations now allow its use as a laboratory for moderate amounts of TRU elements. The injection casting furnace and other fabrication equipment currently being installed into new glove boxes constitute a fairly complete laboratory-scale capability for fabricating several fuel types.

Facility Condition FMF construction was completed in 1986, and it has had some equipment upgrades and reconfiguration since that time. The facility is currently in full operation. Installation of fuel fabricating equipment into newly installed glove boxes is currently underway. The safety authorization basis for the facility is current and complete for the current missions and similar activities. The NEPA and air permitting status is current, and most anticipated activities should be allowed under that status. Significant fabrication operations that are different than previous EBR-II fuel fabrication (e.g., fabrication using large amounts of plutonium) will require a building ventilation upgrade, revision to the SAR, and additional NEPA action. There is no current disposition plan for the facility.

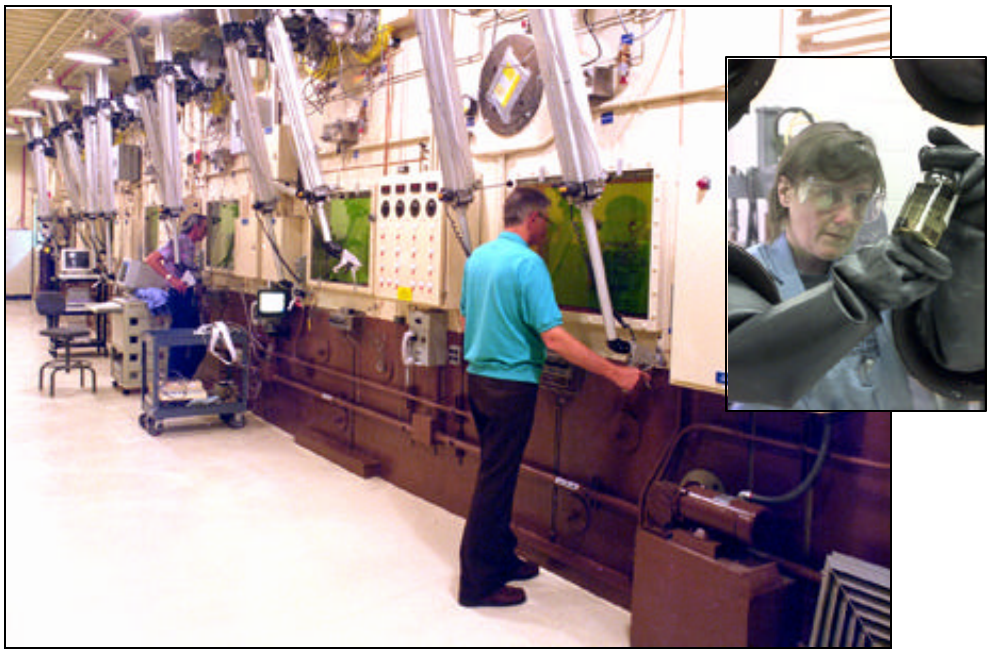
Facility Employment and Costs

FMF	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	8.7	1.5	8.7	1.5
Mission-Capable	(3.2)	(0.8)	(3.2)	(0.8)
Program Execution	0.8	0.15	TBD[5]	TBD[5]
Total Annual Operations	12.7	2.5M	TBD[5]	TBD[5]
One-time deferred maintenance[4]		(0.4M)		
Anticipated one-time cost to prepare facility for anticipated programs[6]				3M over two years

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission Capable"** provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution'** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs" are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. The number of personnel required to accommodate programmatic activity remains to be determined. The numbers of additional programmatic staff in the future will likely range from 5 to 25.
6. The cost shown is for an upgrade to accommodate fabrication of TRU-bearing fuel in FMF. Because such a requirement has not yet been established, the value is shown primarily to indicate a typical scale of modifications to the facility.

Analytical Laboratory (AL)

Argonne National Laboratory-West



Facility Classification Critical Support Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, and any other program at ANL-West (and perhaps at other locations) that requires chemical analysis of radionuclides and elements.

Current Capabilities The Analytical Laboratory (AL) is located at the ANL-W site near Idaho Falls, Idaho.

The AL is a Hazard Category 3 Nuclear Facility and has six negative pressure, air-filled hot cells, each 5.5-ft wide x 5.5-ft deep x 12.5-ft high. Each cell has a 24-inch thick leaded glass, oil-filled window and two remote manipulators. The AL hot cells are equipped for remote chemical analysis of radioactive samples, which is part of the broader capability of the AL. AL instrumentation associated with the hot cells includes inductively coupled plasma spectrometry, atomic absorption spectrometry, gamma and alpha spectrometry, and carbon-oxygen-nitrogen analysis. The facility also includes a wing of glove box equipped and instrument equipped laboratories for analyses of samples that do not require extensive shielding (e.g., samples that have been dissolved and reduced for specific analyses).

Also included in the laboratory are the Casting Laboratory and the Non-destructive Analysis Laboratory. The Casting Laboratory contains a Pu glove box and is used for fabrication of relatively small samples of TRU-bearing materials, such as smaller fuel

slugs for irradiation testing. The Non-destructive Analysis Laboratory supports ANL-W nuclear materials operations by providing assays of accountable material contents.

The facility is fully operational, and provides chemical, radiochemical and physical measurements to support nearly all of the programmatic activities at ANL-West. Analyses and measurements are often performed for organizations outside of ANL (e.g., the INEEL), and Work-for-Others requests to support outside experimenters are often considered and accommodated. Facilities that support AL operation include waste handling and storage facilities, the ANL-West Plant Services complex and Machine Shop, and administration spaces.

Facility Usage The AL is essentially fully utilized, but AL personnel are often capable of taking on additional work projects at various times during the year. Key activities include analytical support of the spent fuel treatment and transmutation fuel development programs now funded by DOE-NE through the Advanced Fuel Cycle Initiative. Other activities include analyses of various efforts to characterize or remediate wastes (or to develop remediation processes), typically funded by DOE-EM, and environmental analyses funded as part of the ANL-W Infrastructure Program. The AL is expected to be an important support facility for most programs anticipated for the ANL-W site, and future work might lead to a need for additional laboratory space. There is no current disposition plan for the facility.

Uniqueness Description The ANL-W AL embodies a collection of analytical expertise and equipment that is unique in the DOE complex and considered to be complementary to that resident in the INEEL's Remote Analytical Laboratory (RAL). The AL is routinely used for chemical analysis of fission products, actinides, and toxic species in a variety of forms. Like the RAL, the ability to analyze fission products, in addition to actinides, in various fuel forms and chemical forms makes the AL unique with respect to other capable analytical laboratories in the DOE complex.

Facility Condition The facility was activated in 1958 and the hot cells were upgraded with new ventilation equipment in 1994. The facility is currently in full operation with all of its current capability intact. However, accommodation of anticipated program activity will require updating and replacing of analytical equipment, for which there is currently no funding mechanism. The safety authorization basis for the facility is current and complete for the anticipated missions. The NEPA and air permitting status is current, and anticipated activities should be allowed under that status.

Facility Employment and Costs

Analy. Lab	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	32.5	6.1	32.5	6.1
Mission-Capable	(6.6)	(1.4)	(6.6)	(1.4)
Program Execution	14	2.9	TBD[5]	TBD[5]
Total Annual Operations	53.1	10.4	TBD[5]	TBD[5]
One-time deferred maintenance[4]		(0.8M)		
Anticipated one-time cost to prepare facility for anticipated programs[6]				TBD[6]

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
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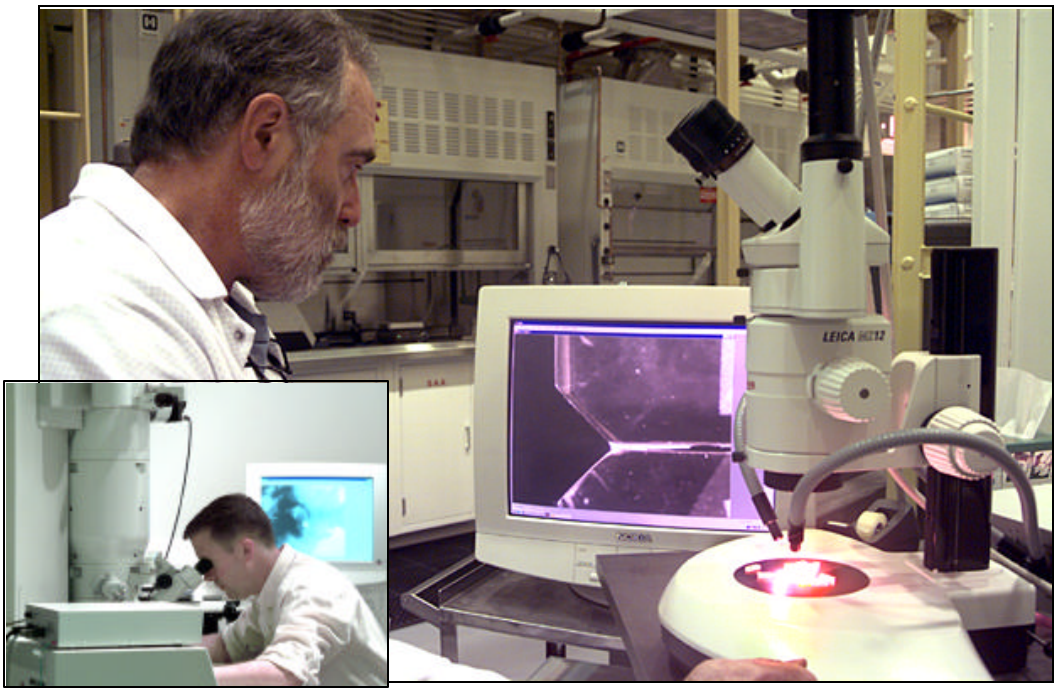
2. Values for "Anticipated Programs" are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. The number of personnel required to accommodate programmatic activity remains to be determined. The numbers of programmatic staff will likely be similar to, or somewhat greater than, current staffing.
6. The Analytical Laboratory is currently well equipped for its current mission and for expected mission activities. Requirements to update equipment in the future remain to be determined, but will depend on specific program needs and available equipping options at the time. In general, $50k to $500k per year is expected to be necessary to maintain and update analytical equipment and instrumentation, depending on the needs for a given year.

Electron Microscopy Laboratory

Argonne National Laboratory-West



Facility Classification Critical Support Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, and other programs that would require examination and characterization of materials.

The Electron Microscopy Laboratory (EML) is used for characterization of fuels, materials, and waste forms in support of programs that develop fuels, that investigate performance of reactor materials, that develop materials for fuel processing, and that treat wastes. All such activities are expected to continue in support of anticipated DOE-NE programs.

Current Capabilities

The EML is located at the ANL-W site near Idaho Falls, Idaho. It is equipped with two analytical instruments; a JEOL JEM-2010 200 kV advanced analytical electron microscope and a Zeiss 960 A scanning electron microscope. These instruments provide fundamental information for understanding materials behavior in complex systems.

The JEOL 2010 is a scanning transmission electron microscope equipped with an Oxford Link Isis energy dispersive x-ray spectrometer (EDS) for chemical analysis. The 2010 has the ability to provide submicron microstructural, chemical and crystallographic information from all types of materials. The Zeiss 960 A is equipped with both a Link Isis EDS and wavelength dispersive x-ray spectrometer (WDS). This powerful

combination allows for both rapid acquisition of x-ray spectra using EDS and high energy resolution acquisition using WDS. The WDS allows for chemical analysis of complex materials consisting of many constituents with overlapping x-ray peaks.
The EML contains a glove box, fume hoods and variety of specimen preparation equipment for preparing radioactive metals, ceramics and small quantities of fissionable material for microscopic examination. TEM specimen preparation equipment includes; a Gatan precision ion polishing system, Gatan dimpler, South Bay tripod polisher, core drill, ultrasonic disc cutter, slurry drill core cutter, and electropolishing equipment. Additionally, the lab is equipped to prepare TEM samples using ultramicrotomy with a Leica Ultracut T Ultramicrotome. For bulk sample preparation and SEM examination, the lab contains a Gatan sputter coater, high and low speed saws, grinding and polishing wheels and a press for metallographic sample mounting.

Facilities that support EML activities include the ANL-W AL, HFEF, and FMF where samples are extracted from materials that require detailed characterization. Other facilities that support EML operation include waste handling and storage facilities, the ANL-West Plant Services complex and Machine Shop, and administration spaces.

Facility Usage EML is currently used for supporting DOE-NE-funded ANL programs, such as spent fuel treatment and development of transmutation fuels, both of which are now funded through the Advanced Fuel Cycle Initiative. Other programs include DOE-EM projects to characterize wastes and to develop methods for their remediation and Work-for-Others programs. The facility is well utilized, but could probably support an increased amount of activity, depending on the nature of the programs. There is no current disposition plan for the facility.

Uniqueness Description The Electron Microscopy Laboratory at ANL-West combines analytical facilities for the characterization and understanding of complex material systems with the unique ability to prepare and analyze radioactive materials. There are few laboratories in the U.S. where electron microbeam instruments can be used to characterize samples that contain actinides and/or fission products. The array of sample preparation equipment also allows preparation of radioactive samples with different types of matrices.

Facility Condition The EML was constructed in a high-bay building that houses the remnant of the Argonne Fast Source Reactor, which is no longer operational. The installation of the EML ventilation system, the preparation equipment, and the electron microscopes was completed in 1998. The facility is currently in full operation with all of its current capability intact. However, accommodation of anticipated program activity will require updating and replacing of analytical equipment, for which there is currently no funding mechanism. The safety authorization basis for the facility is current and complete for the anticipated missions. The NEPA and air permitting status is current, and anticipated activities should be allowed under that status.

Facility Employment and Costs

EML	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	4.9	0.9	4.9	0.9
Mission-Capable	4.2	0.8	4.2	0.8
Program Execution	10	2.1	TBD[5]	TBD[5]
Total Annual Operations	19.1	3.8	TBD[5]	TBD[5]
One-time deferred maintenance[4]		(0.2M)		
Anticipated one-time cost to prepare facility for anticipated programs[6]				TBD

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - "**Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission Capable"** provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution"** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs" are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. The number of personnel required to accommodate programmatic activity remains to be determined. The numbers of programmatic staff will likely be similar to, or somewhat greater than, current staffing.
6. The Electron Microscopy Laboratory is currently well equipped for its current mission and for expected mission activities. Requirements to update equipment in the future remain to be determined.

Transient Reactor Test Facility (TREAT)

Argonne National Laboratory-West

Facility Classification Essential Program Mission Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, other programs that would require transient and/or safety testing of fuels.

The AFCI and Generation IV programs each call for use of new fuel types or compositions. Because safety is a strong emphasis in the early stages of these programs, it will be important to understand the transient response of these fuel types in the early stages of the fuel development programs. Furthermore, more traditional transient testing will be necessary in subsequent years to determine failure thresholds and consequences of failure during specific design-basis accidents. The Transient Reactor Test Facility (TREAT) was designed for such testing. TREAT has also been considered for experiments designed to investigate the coupling of an accelerator-driven source to a subcritical reactor, which would address issues with certain AFCI-related technologies; at the moment, it is not clear whether such experiments will be pursued.

Current Capabilities TREAT is located at the ANL-W site near Idaho Falls, Idaho. TREAT is a graphite-moderated, air-cooled reactor designed for transient testing of reactor fuels and materials and is classified a Category B Nuclear Reactor Facility. The core is easily configured to accommodate experiments of different shapes and sizes, and

the natural temperature response of the reactor provides an automatic shutdown mechanism that passively ensures safety without reliance on shutdown systems. The configuration of the reactor inside the reactor building allows construction of ex-core experimental systems, as required to support an experiment. The diagnostic equipment employed at TREAT during its operation became the standard for similar fuel testing at other locations worldwide.

The reactor core consists of 19 x 19 array of fuel assemblies of highly-enriched uranium oxide fuel dispersed in a carbon and graphite matrix, surrounded by a graphite reflector and concrete shielding. The fuel and reflector assemblies are removable, allowing the core to accommodate test loops and capsules. The TREAT Facility first achieved criticality in 1959 and has been modified and/or upgraded several times since, most recently in 1988. Throughout the reactor's operating history, 6,640 reactor startups and 2,884 transient irradiations were completed.

Facility Usage The TREAT reactor is not currently operating. However, the TREAT reactor building has been used to house development of nuclear materials characterization and processing operations. Sponsors of these recent programs and projects include DOE-EM (primarily) and others.

Uniqueness Description TREAT is one of two operable transient test reactors in the U.S., the other being the Annular Core Research Reactor. However, of the two, only TREAT is designed to test moderate-length prototypic fuel rods or bundles and to accommodate test loops. Other transient facilities are currently operating on other countries. Of those, only the Impulse Graphite Reactor (IGR) in Kazakhstan and the Cabri reactor at Cadarache (France) are sufficiently large to accommodate loops and prototypically test fuel rods and bundles. The design of the IGR is similar to that of TREAT. The Cabri reactor is considerably different in architecture and is scheduled for an upgrade to accommodate LWR fuel testing which will include replacement of its sodium test loop with a pressurized water loop.

The neutronic conditions inside the TREAT core are well-suited for transient overpower testing of fuel. A particularly attractive feature of the TREAT facility is the accessibility to the core provided by the reactor's above-floor configuration. In addition, the design of the reactor's fuel assemblies allows relatively convenient re-configuration of the core to support different experiments, including quick change-out of different test loops. The graphite matrix of the TREAT reactor fuel provides the reactor with a large, negative temperature coefficient of reactivity. However, the Automatic Reactor Control System (ACRS) allows, in addition, the option of terminating transients based on power level, power pulse width, or some test parameter such as fuel or cladding temperature. Using the ACRS, transients can also be customized to produce as desired power vs. time relationship or to provide pre-test or post-test nuclear heating. The TREAT facility is equipped with a neutron Hodoscope for imaging the motion or location of fissile material before, during and after a transient. The TREAT neutron radiography station can be can be used to obtain non-destructive images of experiment configuration (e.g., of fuel rods inside a test loop) before and after a transient test.

Cost advantages of using foreign test reactors are difficult to quantify, because additional costs associated with use of foreign facilities is typically incurred in intangible ways. Such impacts include schedule delays which the U.S. has no control and the additional burden of information exchange to support a program in a foreign facility. However, an ongoing program in Cabri to address reactivity-initiated accident (RIA) issues for LWR fuel is directed by an international collaboration and indicates that international test programs can be successful.

Facility Condition TREAT construction was completed in 1959, and it operated primarily as a fuel transient-testing facility until 1994. Upon the termination of the Integral Fast Reactor Program in 1994, TREAT was placed into non-operational stand-by. The primary barrier to restoration of operations is availability of funds to support personnel allocation to such activities. Reactor operation can be restored upon successful completion and approval by DOE of an Operational Readiness Review (ORR). However, preparation for the ORR requires that operating procedures be reviewed, updated as necessary, and approved; training and requalification of operating staff; and document review to re-establish the facility's safety authorization basis. In addition, some action consistent with the NEPA will be necessary, the scope of which will depend on the nature of the proposed program. (E.g., general consensus is that an Environmental Assessment would be required for resumption of operations, but TREAT operation as part of a larger program might require an Environmental Impact Statement that addresses the impacts of the entire program). There is no current disposition plan for the facility.

TREAT reactor operation can be resumed with about two years of activity, and the reactor could be ready for simpler capsule-type tests within 6 months after approval of an ORR. This would allow operations to resume for the types of experiments that would be needed first. Design, construction, and checkout of a test loop would require 2-1/2 to 3 years.

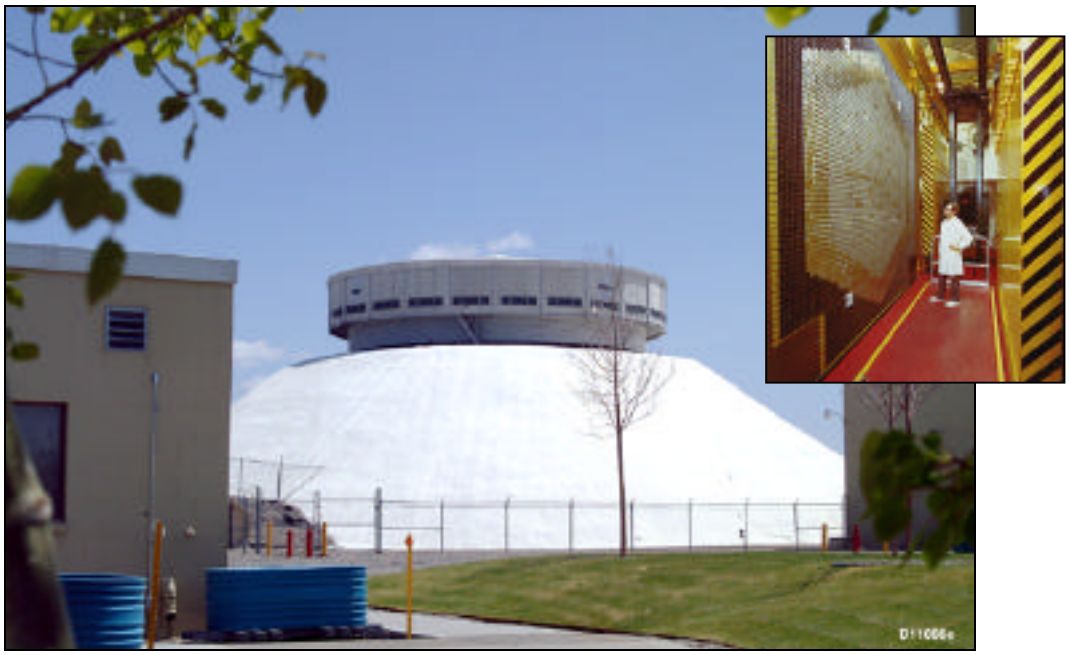
Facility Employment and Costs

TREAT	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	8.5	1.6	8.5	1.6
Mission-Capable	(3.6)	(0.7)	(7.5)	(1.4)
Program Execution	5.6	1.0	17	3.7
Total Annual Operations	17.7	3.3M	33	6.7M
One-time deferred maintenance[4]		(1.3M)		
Anticipated one-time cost to prepare facility for anticipated programs[5]				7M – 21M over several years

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission Capable"** provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution"** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs" are total for full facility support and operations and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. Range reflects estimated one-time costs of $7M over two years for resuming reactor operations, design and fabrication of a single test loop at $12M, and upgrade of the neutron hodoscope for $1.8M.

Zero Power Physics Reactor (ZPPR)

Argonne National Laboratory-West



Facility Classification Essential Program Mission Facility (if program direction warrants)

NE Programs to be Supported Gen IV, Space Nuclear, AFCI and other programs that would require confirmation of a reactor core's nuclear characteristics or the criticality safety of large storage arrays.

The Zero Power Physics Reactor (ZPPR) would likely be used for critical experiments associated with development of a new reactor or accelerator-driven system. Such experiments would be motivated by a design that is outside the range of experiments previously validated by integral experiments, i.e., with significant differences in composition or core arrangement. The experiments might be used to benchmark codes for such systems, or simply to validate code results in which there are some confidence. Through sensitivity analysis, the existing integral experiment database can be objectively used to determine whether additional measurements will be required for a new design concept.

Current Capabilities

The Zero Power Physics Reactor (ZPPR) is located at the ANL-W site near Idaho Falls, Idaho. The ZPPR is a Nuclear Facility, with portions categorized as Hazard Category 2 and 3, and contains a large, split-table critical assembly used for reactor physics studies and measurements using subcritical and critical systems. Associated with the facility is a

large nuclear materials inventory, including plates and rods of fuel materials containing plutonium and/or uranium of varying enrichments and isotopic content.
The facility includes a refined "Gravel Gertie" building, a type of construction originally designed for handling nuclear weapons. The principal experimental area has a very thick foundation and thick concrete walls covered with an earthen mound and a sand/gravel/HEPA-filter roof. This type of construction helped make ZPPR not only the largest, but probably the most precise reactor physics measurement facility in the world. In addition to being explosion-resistant, the facility was designed to contain a conflagration involving a full breeder reactor core loaded with more than three tons of plutonium.

The ZPPR Reactor Cell (Building 776) is a 50-ft. diameter, 23.5-ft high circular room with the floor and walls constructed of reinforced concrete. The reactor cell roof is composed of layers of washed gravel and sand supported by a catenary cable network of 1.875 in. steel cables anchored in a 6-ft. 11-in. wide by 4-ft. 6-in. deep concrete ring beam. The ZPPR Vault/Workroom (Building 775) consists of a 14-in. concrete floor slab, 12-in. thick concrete walls, and a 7-in. concrete roof slab over pre-cast T-beams. The roof and walls are covered with a minimum of 4 ft. of soil. The building was constructed in 1968, and in 1974 the north wall to roof connection was strengthened to allow the building to meet UBC Zone 3 seismic requirements.

Facility Usage Since the ZPPR reactor was placed into non-operational standby in 1994, the facility has since been used to store and manage a portion of the ANL-W nuclear materials inventory. Other operations, primarily in support experiments for other ANL-W programs and projects have been conducted in the ZPPR workroom and reactor cell. The most substantial example was the Gas Generation Experiment, which was terminated in 2002. More recently, ZPPR-related buildings were selected for housing operations to assemble and store Radioisotope Thermoelectric Generators (RTGs), which are presently being transferred to ANL-W from the Mound facility in Ohio. Until the permanent facility preparation is completed, some portion of those operations will be housed in the ZPPR workroom and reactor cell. These interim operations, and the subsequent operations in other ZPPR buildings, are not expected to conflict with any anticipated ZPPR reactor program.

Uniqueness Description The ZPPR facility was designed and built for critical experiments and studies of large reactor cores, primarily in support of the U.S. development of the liquid metal fast breeder reactor. The reactor physics of practically all conceivable fast reactor core sizes, configurations and fuelings were tested at ZPPR. Many of the world's state-of-the-art reactor physics computational codes were validated with ZPPR data. In addition, the facility has been used for various other test programs, including evaluation of space reactor cores and critical safety testing of a mock-up of a remotely operated spent fuel electrorefiner. Similar, but somewhat different, facilities are currently operating in Russia and France. Whether experiments addressing U.S. R&D objectives could be addressed in those facilities would depend on the nature and requirements of specific experiments. Some distinguishing characteristics include ZPPR's horizontal orientation and the existing materials inventory. The materials used at

ZPPR and the facilities in France and Russia are configured specifically for the respective facilities, and it is unclear whether materials from one facility could be effectively used at another.

Facility Condition The ZPPR building was completed in 1968, and portions of the workroom and vault roof were reinforced in 1974 to meet seismic stability requirements. The ZPPR reactor is currently in a non-operational standby status. The ZPPR fuel inventory remains on the ANL-West site, and the ZPPR vault/workroom remains operational to support nuclear materials storage in the ZPPR vault. The stainless steel matrix and the support structure that made up the core, i.e., the critical assembly structure, remains in the reactor cell and is essentially uncontaminated and inactivated. Re-establishing operations of the facility would require training and qualification of operators, updating of operating procedures, minor upgrading of mechanical systems, and preparation and approval of a modern safety authorization basis. NEPA action would likely be required for activities to re-establish operations and for any subsequent program to be conducted in the facility. The air permit for the ANL-W site, which is part of an INEEL air permit addresses the ZPPR facility, but not reactor operation; accommodating reactor operation in a regular update to the permit should not be difficult, as there are essentially no air emissions from ZPPR operation. There is no current disposition plan for the facility.

Facility Employment and Costs

ZPPR	Current Programs		Anticipated Programs[2]	
Readiness Level[1]	Total FTEs	Cost[3] (FY'03 $M)	Estimated Total FTEs	Estimated Cost[3] (FY'03 $M)
Essential	8.7	1.5	8.7	1.5
Mission-Capable	(3.2)	(0.8)	(3.2)	(0.8)
Program Execution	0.8	0.15	TBD[5]	TBD[5]
Total Annual Operations	12.7	2.5M	TBD[5]	TBD[5]
One-time deferred maintenance[4]		(0.4M)		
Anticipated one-time cost to prepare facility for anticipated programs[6]				Roughly 10M Over 2-3 years

1. Readiness level FTEs and costs include infrastructure and operations support personnel that do not work directly in the facility.
   - **"Essential"** refers to the staffing and funds required to meet mandatory health and safety, security, and environmental requirements, and court-mandated agreements. Funding is currently provided by DOE NE Infrastructure.
   - **"Mission Capable** provides well-maintained facilities and support systems that are ready to accept program work. It also provides the core operational staff that can assist programs in planning the program-specific work activities, preparing required ES&H and quality documents, and developing program-specific operations procedures. It does not provide the operations staff to actually perform the program workscope. These recurring workscope activities are currently not funded, thus resulting in degrading facilities and capabilities, and increased deferred maintenance liability. () represents currently unfunded activities.
   - **"Program Execution"** refers to the activities and resources that are required to actually perform the program workscope. This includes facility operators, technical staff, and operations support. The funding for this workscope is provided directly by the Programs and Projects.
2. Values for "Anticipated Programs" are total for full facility support and operations, and are not incremental to those for current programs.
3. Cost values are expressed in FY-03 dollars.
4. Reflects backlog of deferred maintenance that needs to be completed as part of the preparation for new missions and programs. () represent currently unfunded activities.
5. The number of additional personnel required for a critical experiments program is uncertain as it will depend on the nature of the program. However, roughly 10 additional personnel would be required to operate and manage the facility, while the number of R&D scientists and engineers associated might range from 5 to 15.
6. The facility preparation indicated includes the cost of re-establishing operations of the ZPPR reactor, which includes operator training and requalification, procedures updating, minor equipment upgrading, and preparation of a modern SAR.

Alpha Gamma Hot Cell Facility (AGHCF)

Argonne National Laboratory-East

Facility Classification Essential Program Mission Facility

NE Programs to be Supported AFCI, Gen IV, Space Nuclear, and other programs that would require remote examination and characterization of radioactive materials or shielded experimentation.

The Alpha-Gamma Hot Cell Facility (AGHCF) is projected to be used for remote examination and characterization of irradiated fuels and materials in support of any of the anticipated DOE-NE missions. Examination will likely include non-destructive examination, such as dimensional measurements, and destructive examination, such as mechanical testing or metallographic/ceramographic characterization. Other projected tasks include benchtop scale development of recycle processes using irradiated fuels or their derivatives.

Current Capabilities The Alpha-Gamma Hot Cell Facility (AGHCF) is located in Building 212 of Argonne National Laboratory near Chicago, Illinois. The facility has been, and continues to be, used for remote chemical process development, irradiated fuel examination, metallurgical examination, analytical chemistry, radiography, source preparation, and other one-of-a-kind remote operations. The AGHCF is capable of handling a wide variety of radionuclides, including irradiated plutonium fuels.

Currently, the AGHCF is equipped with non-destructive and destructive examination capability. Such capability includes gamma scanning, contact profilometry, fission-gas puncturing and collection, high-temperature furnaces for testing fuels under simulated

accident conditions, and metallography and ceramography. Specialized instrumentation includes a shielded electron microprobe with wavelength dispersive spectral analysis, a scanning electron microscope with energy dispersive spectral analysis, and a scanning Auger microprobe. The AGHCF also has capability for mechanical property testing of materials.

The AGHCF contains a multi-room, kilocurie hot cell. There are ten workstations with remote manipulators and three gloved areas. The majority of the hot cell is maintained under a nitrogen atmosphere, while one cell is air filled and accessible for routine work. All cell walls are made of high-density magnetite concrete with a steel lining.

The facility can ship and receive several cask types, including the T-2, the GE 1500, the GE 100, and the Sugarman casks. All casks are loaded and unloaded dry. The external crane has a 10-ton capacity. The AGHCF also has a chemical laboratory for analysis of contaminated materials, which is equipped with a high-purity glove box, a fume hood, and analytical instruments.

Facility Usage Scheduled and anticipated programs include 1) characterization and testing of high-burnup LWR fuel, 2) evaluation of fuels and materials for long-term storage and disposal, and 3) development of the next generation of low-enrichment fuels. The AGHCF has also supported classified programs with Knolls Atomic Power Laboratory. Some current programs, their successor programs, or similar programs will likely continue to operate in the facility for portions of the next 10 to 20 years. However, those programs are not expected to fully occupy the facility.

Uniqueness Description The AGHCF is one of many currently operating hot cells in the DOE complex. However, the AGHCF is one of a few hot cells that is capable of detailed characterization and testing of highly radioactive fuels and materials. The nitrogen gas inside the cell allows destructive work with essentially any fuel type without concern for reaction with the cell atmosphere. Historically, the link between the AGCF and the HFEF has been almost seamless, and experimenters based in Idaho have found the AGHCF to be a convenient option for hot cell examinations. Similar facilities exist internationally and are used by other nations for fuels and materials examination. However, cost advantages of AGHCF are difficult to quantify, because additional costs associated with use of foreign facilities is typically incurred in intangible ways, such as the schedule delays over which the U.S. has no control and the additional burden of information exchange to support a program in a foreign facility.

Facility Condition The AGHCF was completed in 1964 for examination of irradiated fuels and reactor materials and has had major upgrades in 1967 and 1983. The safety authorization basis for the facility is current and complete for the anticipated missions. The NEPA and air permitting status is current, and anticipated activities should be allowed under that status. It is believed that the AGHCF will remain operational for the foreseeable future to support programs at ANL and from outside of ANL. The AGHCF has routinely been and remains available to experimenters from outside ANL. There is no current disposition plan for the facility.