Tourgroup enters TRA and proceeds down Fogarty Parkway to ATR.

POINT OUT the MTR, ETR and TRA Hot Cells along the way to ATR.

1. Brief History of the Facility (on the way to the facility where possible)

TRA Established: **1952** The Test Reactor Area (TRA) is dedicated to research supporting national DOE missions, including nuclear technology research. The INEEL and Argonne National Laboratory are designated as the Nuclear Energy lead laboratories for reactor technology.

Original Mission: **Studied the effect of radiation on materials, fuels and equipment using seven reactors, especially the Materials Test Reactor (1952-1970), the Engineering Test Reactor (1957-1981), and the Advanced Test Reactor (1967-present).**

The TRA, established in the early 1950s, has been the site for operation of three major test reactors: the Materials Test Reactor (1952-1970), the Engineering Test Reactor (1957-1982), and the Advanced Test Reactor (1967-present). The Materials Test Reactor (MTR) was the second reactor to be operated at the INEEL. (Experimental Breeder Reactor I, now a Registered National Historic Landmark, was the first INEEL operating reactor.) Information obtained from tests run at the MTR influenced the choice of core structural materials and fuel elements for every reactor designed in this country since 1952. The Engineering Test Reactor (ETR) provided more testing space and flexibility than the MTR. At the time of startup, the ETR was the largest and most advanced materials test reactor in the world. The reactor was used to evaluate fuels, coolant and moderator characteristics under environments similar to those in many types of power reactors, including gas-cooled and liquid metal reactors. In 1972, the ETR was modified to support DOE's breeder reactor safety program. The ATR began operating in 1967 (see discussion for *Operating Facilities*).

All of the reactors at TRA have been deactivated except for the ATR and the ATRC. Current plans are to decommission MTR and ETR by 2012. For 50 years, the INEEL has played a key role in both DOE's and the Nuclear Regulatory Commission's nuclear energy research program. The INEEL's contributions helped establish the technical basis for regulating the domestic and international nuclear energy community. TRA is a focal point for implementing this mission. TRA has made many scientific contributions through test programs at facilities such as the Advanced Test Reactor (ATR). The primary mission at TRA is operation of the ATR, the world's premier test reactor, which is used to study the effects of radiation on materials. This reactor also produces rare and valuable medical and industrial isotopes.

Tourgroup enters the ATR building, proceeds to the ATR main floor.

POINT OUT the ATR, and indicate where the ATRC is located.

2. Current Activities at the ATR Facility

Current Mission: **Operation of the DOE-Idaho's only operational reactors, the Advanced Test Reactor and ATR Critical Facility, for reactor fuel and materials research supporting the U.S. Navy and other customers; production of isotopes for medicine and industry, and wet storage of spent nuclear fuel.** *(Note, ANL-W operates the NRAD, a small TRIGA reactor for radiological research.)*

The **ATR** creates a wide range of reactor environments in which the effects of radiation on materials and fuels may be studied. These tests determine how fuels and materials react when bombarded by streams of neutrons and gamma rays under a variety of pressure, temperature, and coolant chemistry conditions. Information that would normally require years to gather from normal reactor operations can be obtained in a matter of weeks or months using ATR's high neutron flux capability. The primary user of the ATR is the Naval Nuclear Propulsion Program. However, this is a multipurpose facility that has several other government, commercial, and foreign users. The unique four-leaf-clover core design provides nine main test spaces. Additional smaller test spaces allow even more experiments to be conducted independently. These smaller spaces are routinely used for production of medical and industrial isotopes.

- ATR construction and operation, typical operating cycles, core internals changeout.
    - Serpentine core, rotating control cylinders vs. vertical control rods, constant axial flux profile. Low pressure 360 psi and low temperature 150F PCS. Closed circuit experiment loops may be high temperature and pressure, prototypical conditions for naval reactor plants.
    - I – 2 week outage to refuel, perform maintenance and install tests, typical 50 day operating run, occasional PALM tests of 1 day or 14 day operation,
    - Every 7 – 10 years replace all core components within the core reflector barrel due to irradiation damage cracking the Be reflector and core components. (duration 4 - 6 months.)

- ATR irradiation and testing capabilities
    - 5×10^{14} n/cm^2 sec fast flux; 1×10^{15} n/cm^2 sec thermal flux at 250 MW
    - 9 Flux traps: 5 loop irradiation facilities, MICE facility, and 3 addl. Flux traps
    - Instrumented lead experiments
    - Numerous drop-in capsule experiment locations

- NR use of the ATR, coordination with Naval Reactors Facility, Bettis interface.
    - NR provides test trains for 5 loop irradiation and MICE facility
    - Test trains are assembled and shipped from NRF (on-site shipment, 5 miles)
    - Receipt and insertion of irradiated tests from NRF (duration 4 – 6 hours)
    - NR experiments are coordinated through on site Bettis management/engineers.
    - NR tests are normally returned to NRF for post irradiation examination, reassembly and return to ATR for additional irradiation.

- Typical experiment development schedule.
    - Conceptualization – 2 years to 18 months early
    - Design – TRA Engineering coordinating with customer, 18 months to 1 year early
    - Fabrication – TRA Machinists, extensive QA checks, 6 – 12 months early
    - Safety Analysis – to demonstrate safety during test, 3 – 12 months early
    - ATRC testing – quantify nuclear physics affects on ATR, 2 – 3 months early
    - Back-up test – nuclear equivalent dummy test, 3 months early
    - Irradiation – Insertion into ATR during outage, designated power levels
    - Post Irradiation Exam – transfer to TRA Hot Cells for exam and/or shipment

ATR Milestones

July 2004	Commence ATR Core Internals Changeout
February 2005	Resume ATR Test Plan, Cycle 134B

The **ATR Critical Facility** is a low-power, full-size nuclear reactor, a nuclear duplicate of the ATR, designed to provide physics data in support of the ATR test program.

- ATRC support to the ATR.
    - ATRC is low power (5 kW), pool type reactor, full-size nuclear mockup of ATR
    - Highly complex nuclear physics modeling is difficult, accuracy is fair to poor
    - Actual measurement of nuclear effects is highly accurate
    - Most new tests are measured in ATRC prior to insertion in ATR

A **Physical Security upgrade** is proposed that includes a separate security fence around the ATR facility with controlled access for workers.

Exit the ATR main floor to the ATR canal area.

Point out the ATR spent fuel storage racks and the storage of other ATR irradiated components.

The **ATR Canal** is where irradiated items, components and targets are placed after removal from the ATR. Transfer Chute is configured to enable materials to be passed underwater from the ATR vessel to the canal. Gates within the canal, and redundant water supplies lined up to the canal, provide protection for loss of shielding/ fuel cooling in the event of canal leakage.

Irradiated Fuel Storage

Irradiated ATR fuel is stored in the canal until it is either reused in the ATR, or if it is no longer to be used, until the fission products have decayed sufficiently for shipment to INTEC.

Irradiated components

Some ATR core components removed during previous CICs are still stored in the canal.

Gamma Tube Irradiation system

For those customers who desire gamma irradiation of specimens in extremely high gamma fields, the gamma tube may be used. Irradiated ATR fuel is positioned around the bottom end of the tube to supply the gamma flux and the specimen is placed inside the dry gamma tube.

Door 51 access through confinement to ATR main floor.

Exit the ATR facility and turn left, following Buchanan Blvd. and Bass Ave. to the vicinity of the ATR cooling towers. Then Proceed Eastward along Bass Ave.

POINT OUT the ATR substation, ATR Main Stack, the ATR Cooling Towers, and the secondary pump house, TRA-671.
POINT OUT the TRA Water Tanks, including the 1 million gallon tank and TRA-688, Firewater Pumphouse.
POINT OUT TRA Fuel Oil Storage tanks, TRA-628, Engineering Bldg., TRA-619, TRA Pump House Deep Well Pumps, and TRA Electrical Substation

The ATR Cooling Tower removes the heat generated during ATR operation. Reactor heat is transferred to the secondary coolant in 5 large primary to secondary Heat Exchangers located in the ATR, the heat is removed in the cooling towers, and released to the atmosphere in the water vapor.

The TRA Fire Water system was upgraded as a portion of the Fire and Life Safety Upgrade project during the 1999 – 2001 time frame. The million-gallon tank provides a backup source of firewater and serves as an independent source of water for emergency core cooling in the event of a loss of reactor coolant accident at ATR.

TRA Fuel Oil Storage tanks

The three smaller tanks store diesel fuel for the three diesel generators at ATR. The two larger tanks once held fuel for heating boilers but are now empty and clean.

TRA-628, Engineering Bldg.

TRA-628 provides secure workspaces for engineers and others working on classified experiments conducted at the ATR.

TRA-619, TRA Pump House

Several raw water pumps in this building distribute well water from the three large tanks behind the building to the overhead storage tank southeast of us and to other uses throughout TRA. Also in this building are two firewater pumps, one electric and one diesel powered.

Deep Well Pumps

Three deep wells and associated pumps supply the roughly 50 million gallons per month of water TRA needs from the Snake River Aquifer located about 460 feet below the surface of the ground.

TRA Electrical Substation

138,000-volt power is supplied to TRA from a redundant INEEL loop. The power is purchased under site contract from commercial suppliers in Idaho, Utah and Montana. The ATR cannot operate without commercial power and scrams immediately when it is lost.

Turn RIGHT on Salmon St. and proceed to the cafeteria.

POINT OUT the TRA Demineralizer Building, TRA-608 on the LEFT, and the TRA Utilities Building, TRA-609, on the RIGHT.
POINT OUT TRA-780 and the TRA Water Tower on the LEFT, and the TRA Cafeteria Bldg. on the RIGHT.

The TRA Utilities buildings, TRA-608, the Demineralizer building and TRA-609, the Plant Utilities building, provide demineralized water and compressed air to support ATR operations. These buildings were originally built in the early 1950's, and have provided utilities to the MTR and ETR over the years. The Demineralized water system was upgraded to a state-of-the-art Reverse Osmosis system in 2002.

The TRA 150K Gallon Above Ground Storage Tank provides positive pressure to the TRA fire water system and the ATR emergency cooling system in the event of a loss of the fire water system pumps.

TRA-780, Temporary Accumulation Area provides a controlled location for temporary storage of CERCLA Wastes at TRA.

The TRA Cafeteria, a 1950's vintage building, is in need of replacement.

Turn RIGHT on Perch St. and then South toward TRA-604. Stop in front of TRA-604

POINT OUT Office Buildings TRA-649 and 652. POINT OUT the Radiation Measurements Laboratory, housed in the TRA–604 EM owned facility

TRA-649 and 652, and 604 Lab facilities - These administrative offices and laboratories are located in early 1950s vintage buildings. These buildings are in need of replacement. About one third of the research and analytical work done here is in support of EM, about one third is in support of NE, and the final third supports ATR, the Defense/NNSA, and other programs.

The **Radiation Measurements Laboratory** specializes in measuring the quantity and quality of alpha, beta, gamma, and neutron radiation. This 1950's vintage facility is in need of replacement.

The **Radiochemistry Laboratory** is used to support the Radiation Measurements Laboratory as well as to carry on independent research and development work. Investigators here study ways to produce and purify medical radioisotopes, as well as studying the effects of radiation on hazardous waste.

- Radiation Measurements Laboratory (RML) provides radioanalytical support capabilities
    - Radiation Measurements
        - full range of state of the art radiation measurements
        - gamma, gross alpha and beta, neutron measurements
        - supports ATR operation, experiments, and waste management
        - research and development of new radiation measurement capabilities
    - Analytical Radiochemistry
        - routine analytical analysis (liquid scintillation, alpha spectrometry, etc.)
        - supports ATR operation, waste management, and other RML activities
        - elemental analysis (gas chromatography, atomic absorption, inductively coupled plasma, and wet chemistry techniques.)
    - Radiochemical Research and Development
        - develop and establish new and better separations measurement techniques, primarily involving rare earth elements, actinides, and tritium
        - hot Cells used to prepare samples and sources
        - mass spectrometers support determination of isotopic ratios
    - Field Measurements and Site Characterization
        - Mobile laboratories for analysis of air, soil and wipes for TRU and gamma
        - Special equipment for mapping radiologically contaminated areas
        - Assessment of waste containers and measurement of stack velocities

- Mass Separator Laboratory
    - Laboratory-scale electromagnetic mass separator produces 50 keV ion beam
    - Isotopic (mass) separation and implantation of both stable and radioactive ions
    - Unique ^{252}Cf coupled mass-separated sources of short-lived fission products

Continue East on Marlin Ave, past TRA-603, MTR Building.

POINT OUT the MTR Complex, currently owned by EM.

Idaho Completion Project

- Significant interface with the Idaho Completion Project will be required between 2005 and 2012. Emphasis areas include completion of voluntary consent order activities; decontamination and decommissioning of inactive or obsolete buildings; and transitioning responsibility for long-term stewardship responsibility of Waste Area Group 2 remedies. Funding of voluntary consent order corrective actions is co-funded by NE and EM.

MTR Vessel Structure TRA-603/604
Classified as a low hazard radiological facility. Criticality was first attained March 31, 1952. The reactor was shut down for the last time on August 21, 1970. The MTR reactor and canal have been defueled. The MTR core and reflector structure is located in the center of the MTR Reactor Building (TRA-603). The reactor vessel still contains the beryllium reflector and a graphite reflector formed from solid graphite bars and 1" diameter balls. There is approximately 70 tons of graphite inside the vessel structure. Supporting the shielding structure in the reactor building basement is a concrete base enclosing the reactor subpile room. The portion of the canal beneath the reactor has been drained and is isolated by a bulkhead. The remainder of the MTR canal is currently being cleaned and drained as part of ongoing D&D efforts.
Remote systems test platforms (TRA-603 Main Floor)
Because of the unique high bay area on the MTR Main Floor, this area is used by the Remote Mockups Group to develop and test remote tools/fixtures and robotic systems in support of the INEL, predominantly INTEC.
Material staging area (TRA-635)
Provides storage/staging area for maintenance work orders that are working and/or scheduled to work soon.
Excess Material Control Area (TRA-635)
Operated by Waste Generator Services (WGS). Provides area for segregation and storage of excess material and recycleable materials.

EM Complex of buildings identified for D, D & D.
TRA-604 – *the basement contains numerous swithgear panels and utilities that provide power, water, air and drains to the MTR complex and several out-lying support buildings. The MTR Exhaust Fans are located in the center cubicles and are actively used to support radiological work/systems. The 604 basement houses the TCAS (security post with associated monitoring systems and access control systems). The basement is also used for storage by R&D and ATR (reactor spare parts).*
TRA-661 – *contains the R&D chemistry laboratories , a hot cell facility and associated office areas.*
TRA-668 – *contains the RML and associated office areas.*
TRA-649 & -652 – *contains most of the Administrative Support personnel for the TRA and ATR, including TRA Project Management, TRA SAD, Budget, and Document Control personnel.*
TRA-654 (ETRC) – *used by R&D Labs for several on-going projects.*
TRA-610 (MTR Fan House) – *houses active MTR Stack supply fans for MTR and is used as a storage area for commercial items by the Electrical Shop.*
TRA-626 – *used as a storage area for Laborer equipment. Also house power distribution centers that supply the STAR facility (TRA-666), Hot Cells (TRA-632), Material Staging Area (TRA-635), as well as other miscellaneous loads.*

Turn RIGHT and proceed South on Pike St.	***POINT OUT the NMIS Facility and the STAR Facility.***

The **Nuclear Material Inspection and Storage** facility is a high-security facility used to store and inspect the unirradiated "fresh" fuel for the ATR. More than three years worth of fresh fuel is normally kept on hand. Security enhancements are also planned for the NMIS facility.

The **Safety and Tritium Applications Research (STAR)** Facility is an INEEL User Facility for fusion-related research and development for the DOE Office of Fusion Energy Science. The research focuses on how radioactive and hazardous materials behave in fusion machines. Two key research areas are tritium behavior in materials exposed to plasma and chemistry and behavior of tritium in molten salts. The fusion research involves scientists from both national and international laboratories.

Safety Tritium Applied Research (STAR) Facility Tritium Research Laboratory:

- A wide variety of experimental systems to analyze irradiated and clean samples
- Glovebox systems for high pressure and temperature gas experiments
- Thermal-desorption and quadrupole mass spectrometers capable of measurements of high temperature materials up to 900C
- Fusion related research using deuterium implantation permeation for H_2 interactions

Turn RIGHT on Walleye Ave.

POINT OUT the ETR Complex that is currently owned by EM.

ETR Vessel Structure
Categorized as a low hazard radiological facility. ETR began operating in 1957 as a 175-megawatt light-water cooled and moderated, beryllium-reflected reactor. One of its many missions was to characterize engineering features of a sodium cooled reactor. The most significant residual radioactive source term is the reactor vessel and its internal structural support and components. The ETR was rendered inactive in 1981. The reactor vessel is defueled and the canal is drained. Main floor area is used for storage of the Hot Waste Tanker (currently not in use) and the ATR In-Pile Tube shipping boxes.

ETR Basement areas - *Two basement levels and a subpile room.*

ETR Complex of buildings identified for D, D & D.
ETR Filter Pit Building (TRA-755). *The filter pit building is approximately 13 ft by 13 ft by 13 ft building constructed of pumice blocks. The building is located about northeast of the compressor building and houses fans associated with experimenter's service exhaust.*
ETR Underground Exhaust Pits and Tunnels

GEEL Pipe Tunnel - *The original experiment exhaust system used the underground GEEL pipe tunnel and hot filter pit. The exhaust piping starts in the ETR basement and runs through a trench in the basement to a vertical shaft on the north side of the building near the truck door. The pipe tunnel runs north from the building for approximately 90 ft. It then runs east for about 155 ft to the hot filter pit.*

Hot Filter Pit - *The hot filter pit houses three filters designated as the Loop 33, Loop 66, and Loop 99 hot filters. These filters are a canister charcoal-activated type contained in a lead and concrete shield.*

Primary Filter Pit (TRA-704) - *The primary filter pit houses two filters.*

Secondary Filter Pit (TRA-705) - *The secondary pit also houses two filters and is the same size as the primary pit.*

Delay Tanks Pit (TRA-706) - *There are two delay tanks located in this pit. Each tank is arranged in a housing of an approximate cylindrical cross-section*

ETR Secondary Pipe Pit. *The secondary pipe pit is an underground structure on the south side of the heat exchanger building. The function of secondary pipe pit was to house the Secondary Coolant System (SCS) heat exchanger isolation valves and the SCS drain sump and sump pump.****ETR Air Intake Buildiung (TRA-655) -*** *currently used for some storage of supplies used to support the TRA-713 tank inspections.****ETR Office Building (TRA_644) –*** *area is empty.*

Superior Diesel Building (TRA-663) - *houses the emergency diesels that supported the ETR.*

TRA- 648, ETR Electrical Building – *Most electrical loads that support the ATR have been removed from the building under the Electrical Utility Upgrade (EUU) with the exception of the #3 Deepwell Pump. It is scheduled to be swapped during CIC. The building still supplies some power loads to the maintenance shop and the ETR facilities.*

Environmental/Compliance Activities at TRA

The Idaho Department of Environmental Quality (IDEQ) and the DOE-ID entered into a Voluntary Consent Order (VCO) in June 2000 to correct potential Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) non-compliance. One non-compliant condition is the unknown condition of various tanks in the facility. The corrective actions for these conditions will be developed based on the condition of the tank(s). The actions will be performed in accordance with contractor procedures.

Turn LEFT on Walleye Ave. stopping at TRA-632, TRA Hot Cell Facility.

POINT OUT the TRA Hot Cell facility.

The **TRA Hot Cell Facility** was built in the early 1950's to support the irradiation testing at the MTR. The facility originally contained one hot cell, located on the east end of the building. In the late 1950's, the facility was expanded to include two more hot cells, to support the additional testing being conducted in the ETR. The facility contains three hot cells equipped with remote-control machine tools, measuring instruments, and manipulators. The cells are used to disassemble experiments following irradiation, study metals, test irradiated samples, and process radioisotopes. Within the TRAHC facility is a separate Test Train Assembly Facility, dedicated to assembling new experiments and preparing them for insertion in the ATR.

Isotope production capabilities.

- Prior work at ATR Hot Cells produced and sold large quantities of ^{192}Ir & ^{60}Co, etc.
- Current ATR capacity to accommodate extensive isotope production
- Requires TRA Hot Cells for packaging and shipping product to customer
- NE interest in producing various industrial and medical isotopes
- 50 year old facility is in need of replacement to support anticipated future workload

Currently, the TRA HC facility has been in a shutdown status since October 2001. A new Documented Safety Analysis (DSA) is being prepared and is undergoing review and approval. Upon approval, the new DSA will be implemented. Following DSA implementation, an ORR is planned to return the facility to operation.

Turn LEFT and proceed South on Sturgeon St. Enter the TRA-653 Maintenance Facility, East door, and exit the Machine Shop south door.

POINT OUT Point out TRA-648, ETR Electrical Building (EM), the new TRA Electrical distribution station and the ATR Sponsor's Warehouse, the TRA-653 Maintenance building, offices, change rooms, craft shops and Machine

New TRA Electrical Distribution station – part of the EUU Project to remove older equipment and to remove electrical loads that directly support the ATR from the facility in preparation for D&D of the ETR facility.

ATR Sponsor's Warehouse (TRA-662) - QA controlled storage area containing spares and materials that support the ATR and the sponsor's experiment program. The south side of the building houses the TRA "large" Machine Shop which contains several unique mills, lathes, and shaping machines that support work throughout the INEL.

TRA Maintenance building (TRA-653) - The Machine Shop is a high bay area that occupies the west half of the building with numerous mills, lathes, CNC machines and heat treating capabilities. It is currently the only active machine Shop at INEL and provides all of the machining capability for the site. The Electrical Shop occupies the north end of the building. The south end of the building houses the locker room/change room for the craft personnel. The Fitter/Welder Shop is located between TRA-653 and TRA-662. The second floor of TRA-653 houses the TRA Maintenance Planners, Schedulers and TRAMO management.

Cross Whitefish St., To Fogarty Way, and back to the TRA Guardhouse.
Proceed directly to the TRA-658 Guardhouse.

POINT OUT TRA-679, TRA Nuclear Training Facility, and TRA-680, TRA Emergency Command Center

The **TRA Nuclear Training Facility** contains classroom training facilities for conducting training for all TRA employees, and a full scale simulator of the ATR Control Room for training the ATR Shift Crews. Any evolution that can occur in the ATR can be programmed to occur in the simulator, providing a highly realistic training environment for the Control Room personnel. Modifications to the ATR are first installed in the ATR simulator, to complete development and software debugging prior to installation in the plant.

The TRA Emergency Command Center is a fully self-contained Emergency Response communications center. TRA Managers and Shift personnel are qualified as Emergency Response Organizaton team members, with specific responsbilities defined within the INEEL Incident Command System, to provide an integrated command and control organization to respond to an emergency event at TRA or elsewhere at the INEEL.

3. Future Vision of the TRA Facility

The prime program sponsor, Naval Reactors, has indicated that they expect to continue naval nuclear fuels and materials testing in the ATR for the "foreseeable future." NR has been a highly reliable sponsor; however, with increasing fiscal constraints, NR is pursuing options for reducing costs associated with ATR operations. (e.g. NR funding used to be $62M/year in the early 90's)

With the transition to the NE program as Lead Principal Secretarial Office, and designation (with Argonne National Laboratory – West) as the NE Lead Laboratory for Nuclear Research, TRA is prepared

to assume the lead role in new nuclear research within the DOE. The current administration is supporting a rebirth of nuclear energy, and there is much anticipation of significantly increased nuclear research within the department. New programs such as the Advanced Fuel Cycle Initiative, Generation IV Nuclear Reactor Program, Space Reactor Program, and Nuclear Hydrogen Development are being promoted as part of this rebirth. Each of these programs is expected to need irradiation testing for multiple experiments in the ATR.

NE is independently working to reach agreement with TRA on a MOU for commercial isotope production and distribution using ATR and the TRA Hot Cell facility. Indications of interest from several commercial customers for isotopes support this plan.

These independent forecasts collectively provide a bright outlook for the future of ATR.

To support this anticipated expansion of ATR irradiation testing, TRA infrastructure needs to be "recapitalized" to restore reliability and capability. As an example, many existing facilities are obsolete and in need of replacement with new more capable facilities (e.g. radioanalytical labs, Hot Cell facility, administrative buildings and cafeteria.) Budget requests for a significant increase in capital funding beginning in FY-05 are being developed to support this vision.

New business challenges

- Expect a significant increase in ATR experiment load for non-NR customers
- Must have adequate experiment support, operations support & operations staff