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Proposal for New Argonne SRF Facility

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Why a new SRF facility?

1. **A proposed ion source (EBIS) upgrade of ATLAS would require relocation of the cavity cold test area**

2. **ATLAS is funded to build another new cryomodule. The existing cryomodule assembly area (clean room) is in poor state of repair and should not be used further**

Outline

- ***Existing Facilities***
- ***Activities at ANL SRF Facilities***
- ***Options for a new ANL SRF facility***

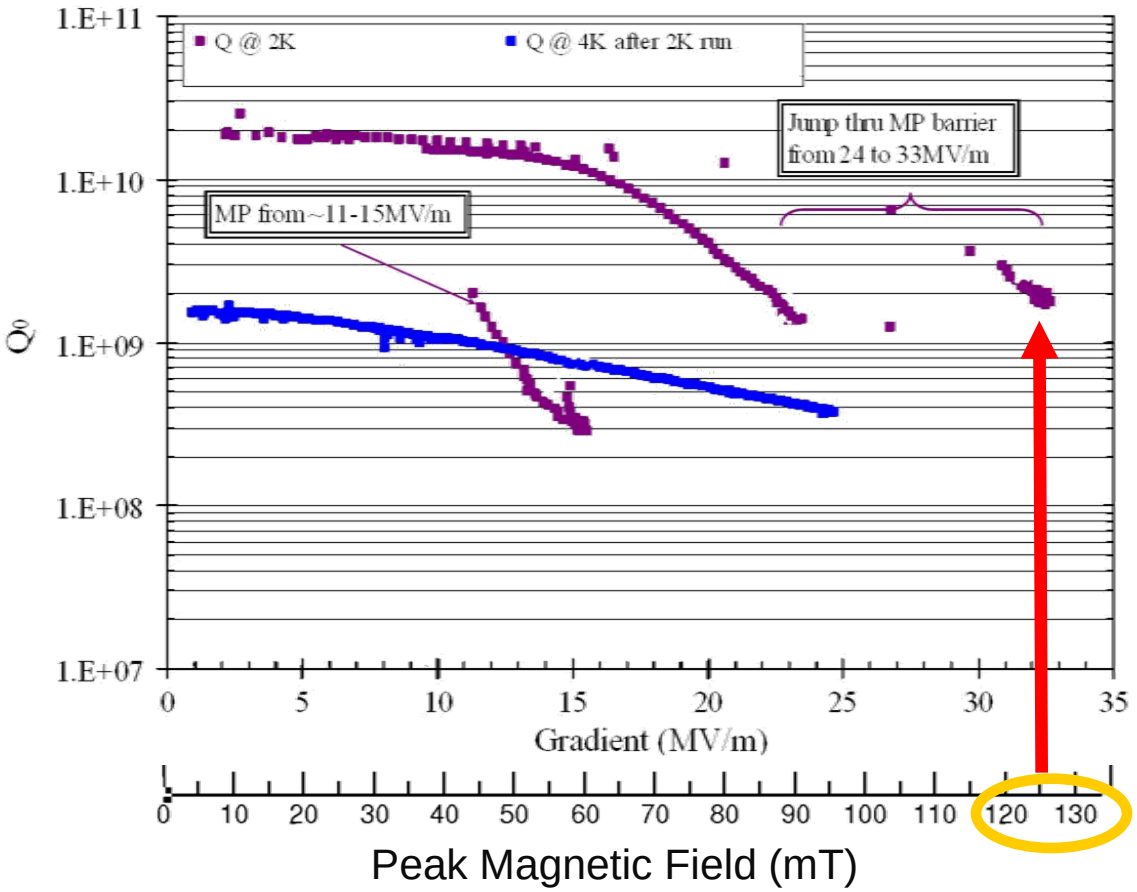
I. Facilities: G150 Laboratory for Cavity Chemistry and Cleaning

Chemical polishing of a triple-spoke cavity

HPR and assembly of a single spoke for FNAL

- **Valuable facility for recent SRF activities (ATLAS upgrade, 3.9 GHz and HINS at FNAL)**
- **Should maintain this facility for prototyping**

I. Facilities: A 30 MV/m Single Spoke Cavity for HINS from G150

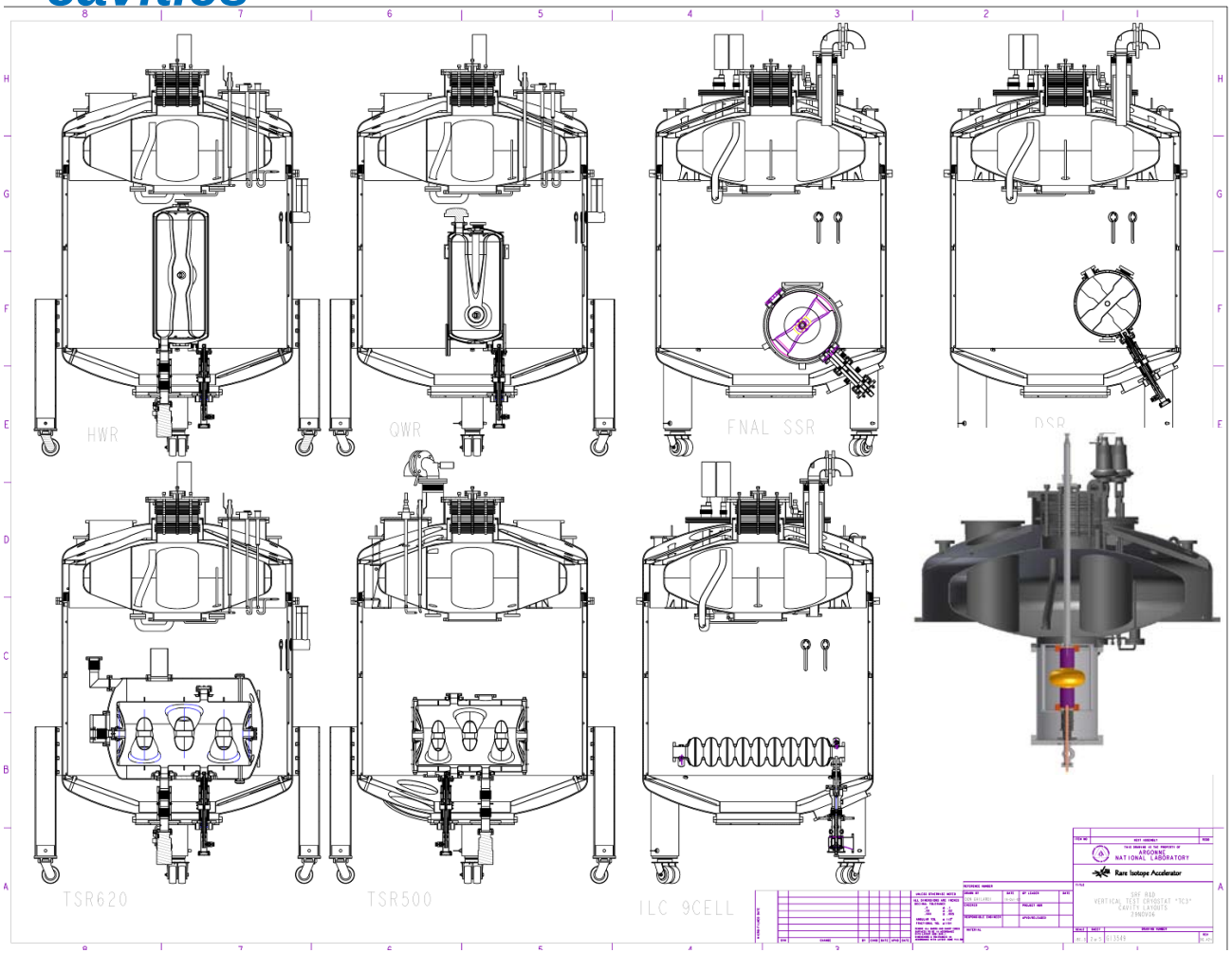


- **Comparable voltage/length as for high beta; 4.5 MV acc. voltage in 1/3 meter long cavity!**

I. Facilities: Cavity Cold Testing Facility in ATLAS

- **Two shielded test caves**
- **Two operational large vertical test cryostats**
- **Full time connection to ATLAS helium refrigerator for 24/7 operation**

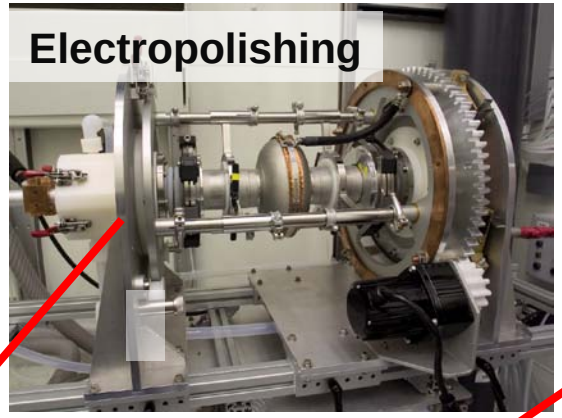
I. Facilities: Full time 2.0 – 4.5 Kelvin cold testing of SRF cavities

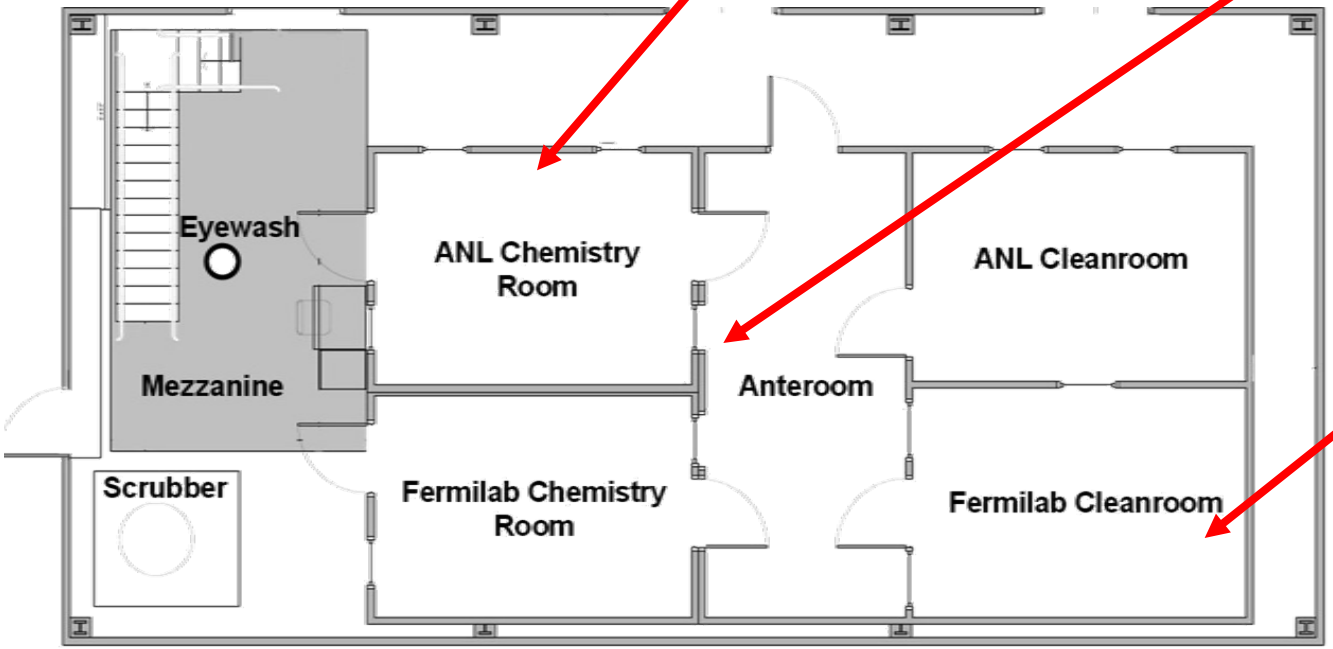


- **Initial testing at 2 K with half-wave cavity next month**
- **~$100K expansion of 1.3 GHz RF systems to test (ALD coated) single cell cavities**

I. Facilities - Joint ANL/FNAL Superconducting Cavity Processing Facility at ANL

- 2000 ft^2 facility
- Capability for range of SRF cavities
- Nearly two dozen full cavity processing procedures for FY09
- Five 1.3 GHz single cells with E_{ACC}>35 MV/m





I. Facilities: Clean room Assembly of SRF Cavity Strings

II. SRF Activities

- ***ATLAS Upgrade***
  - **A new upgrade of the ATLAS SRF linac funded, including the cost of a new cryomodule of superconducting cavities.**
  - **Subsequent upgrades would require the fabrication and installation of as many as five additional cryomodules into ATLAS.**

- ***Project X Cryomodule Production***
  - **Fermilab plans to begin construction of a superconducting proton linac for Project X in 2013 requiring 45 cryomodules of superconducting cavities similar to those built for the ILC**
  - **7 cryomodules of superconducting spoke cavities for the low energy portion of the superconducting linac.**
  - **FNAL cryomodule assembly capacity of 2 modules/month will not, by itself, be sufficient to meet all the needs of the Project X production schedule.**
  - **With ANL experience on beta<1 cryomodules, the new facility would be ideally positioned to support this effort.**

II. SRF Activities

- ***APS Deflecting/crabbing cavities***
  - **SRF deflecting cavities for the production of short x-ray pulses**

- ***Atomic Layer Deposition (ALD): R&D for Next Generation SRF***
  - **Atomic layer deposition techniques can be use to conformally coat a wide range of materials with arbitrarily complex shapes**
  - **At ANL, ALD produced alumina and niobia bilayers have already been successfully applied to 1.5 GHz SRF cavities**
  - **Major advances possible with, for example NbN layers**

- ***SRF Facility for the production of radioisotopes at ANL***
  - **80 Cavity, 11 cryomodule SRF proton/deuteron linac**

III. Options for a New SRF Facility

A substantial new SRF test facility can be implemented on a relatively quick timescale and low cost based on:

- **Large existing, well equipped and unoccupied high-bay areas in both the building 200 and 300 areas at ANL**
- **An available liquid helium refrigerator capable of delivering 40 Watts of cooling at 2 Kelvin or 150 Watts of cooling at 4 Kelvin**
- **Readily available radiation shielded areas and/or shielding block for cavity and cryomodule test areas**

Table 2. Added value of existing infrastructure (in k$)

Building	203	208	367	366
High-bay floor space	823	1375	1890	1890*
CTI Cryogenics Model 1630 4 K	600	600	600	600
2 Kelvin test cryostat	250	250	250	250
Overhead crane	50	50	130	130
Total value added	**1723**	**2275**	**2870**	**2870**

*SRF facility space only; total floor space is 23,000 sq. ft.

III. Options for a New SRF Facility

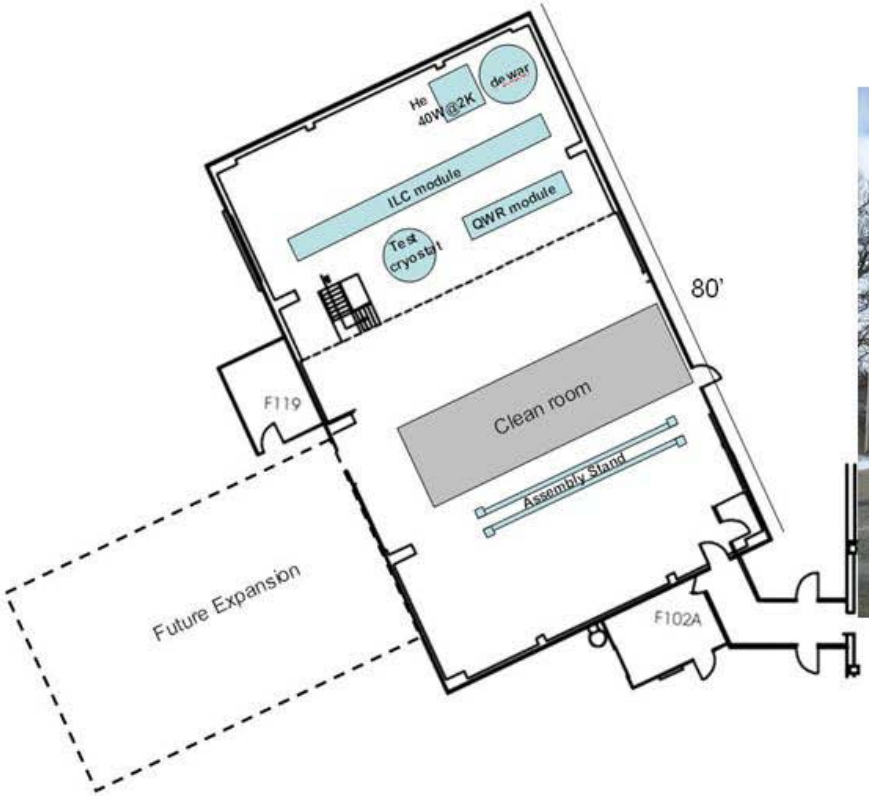


Figure 1. Layout for an SRF facility in F-Wing 208 high-bay. The high-bay is located adjacent to the existing single cavity processing facility. Total existing floor space ~4000 sq. ft. with room for expansion.

III. Options for a New SRF Facility

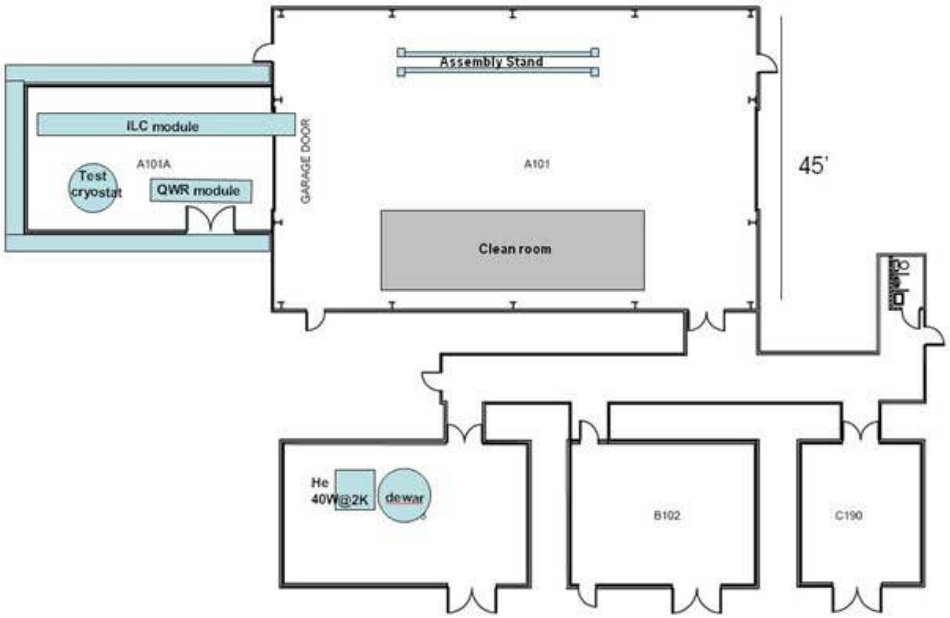


Figure 2. Layout for an SRF facility in 367 high-bay. Total floor space ~5300 sq. ft.

III. Options for a New SRF Facility

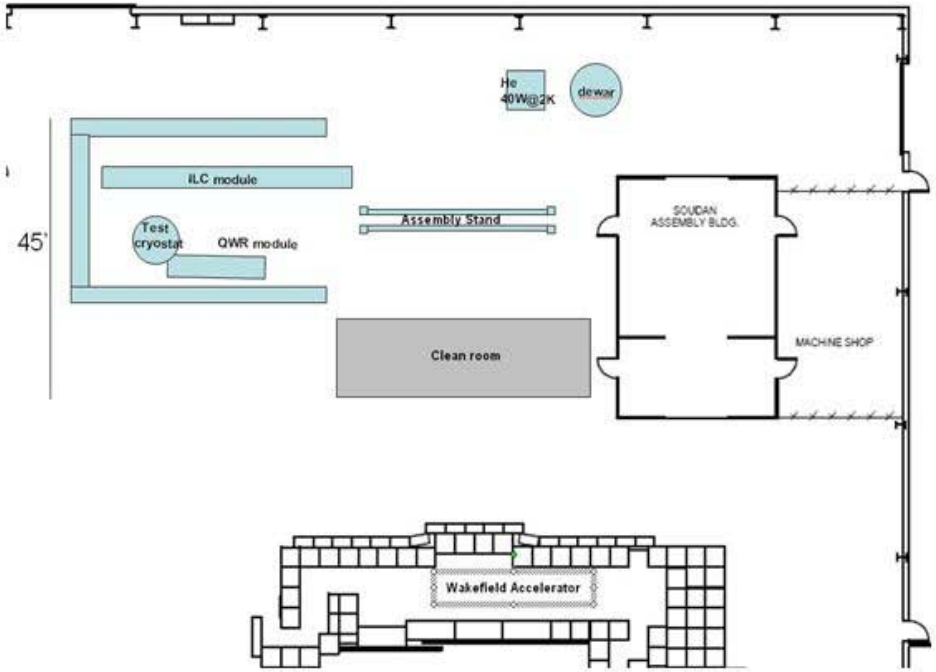


Figure 3. Layout for an SRF facility in 366 high-bay. Total floor space ~23000 sq. ft. Only a portion of this high-bay would be used with SRF facility space of ~5300 sq. ft.

III. Options for a New SRF Facility

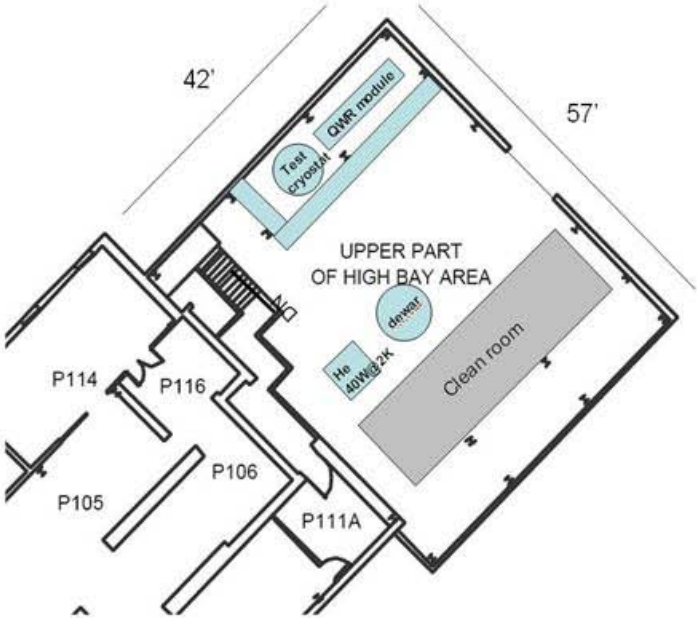


Figure 4. Layout of SRF facility in Dynamitron. Total floor space ~2400 sq. ft. This high-bay space would accommodate a substantially reduced sized clean room and cold test area.

III. Options for a New SRF Facility

Table 1. Cost estimate for SRF facility

Facility cost including manpower and M&S	Dynamitron k$	208 F-Wing k$	367 High-bay k$	366 High-bay k$
Floor space preparation	500	100	50	50
Fire Suppression	0	110	0	0
HVAC	0	100	150	0
Crane (10 ton gantry + auto-style lift in 208)	50	90	0	0
Test Cave (40' x 10' x 3 ft thick)	60	0	90	90
HEPA filters	80	80	80	80
Clean room structural	75	75	75	75
Clean room electrical	20	20	20	20
Clean room roof fall arrest	30	30	30	30
Refrigerator electrical (800 Amps @ 480 V)	40	200	40	40
Installation of 150 W 4K refrigerator	283	371	346	346
Oxygen deficiency hazard mitigation	30	30	30	30
Vacuum systems	50	50	50	50
Electronics/relay racks/data acqu/computer	40	40	40	40
Cavity/cryomodule assembly stand	50	50	50	50
Rigging/transport of hardware	30	30	30	30
2 Kelvin test cryostat (duplicate of existing)	250	250	250	250
Contingency (40%)	635	650	532	472
Total	**2223**	**2276**	**1863**	**1653**

Final Comments

- ***Many SRF activities at ANL spanning several divisions (ONP, HEP, BES) of the DOE office of science***
- ***Should be supported by each of these divisions***
- ***A strong facility can be built with both substantial time and cost savings at ANL based on existing expertise, infrastructure, and equipment***