Fermilab | U.S. DEPARTMENT OF ENERGY | Office of Science

ACORN

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2021 All Engineers Retreat

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In partnership with:

INL
Idaho National Laboratory

Overview

ACORN is a project that will modernize the lab's accelerator control system.

- ACORN project status
- Recent project activities
- Future R&D and opportunities

Image Credit: Jacobs Engineering - Pre-conceptual design for a new Main Control Room in a future Center for Accelerator Science and Technology (CAST).

Accelerator Controls Operations Research Network (ACORN)

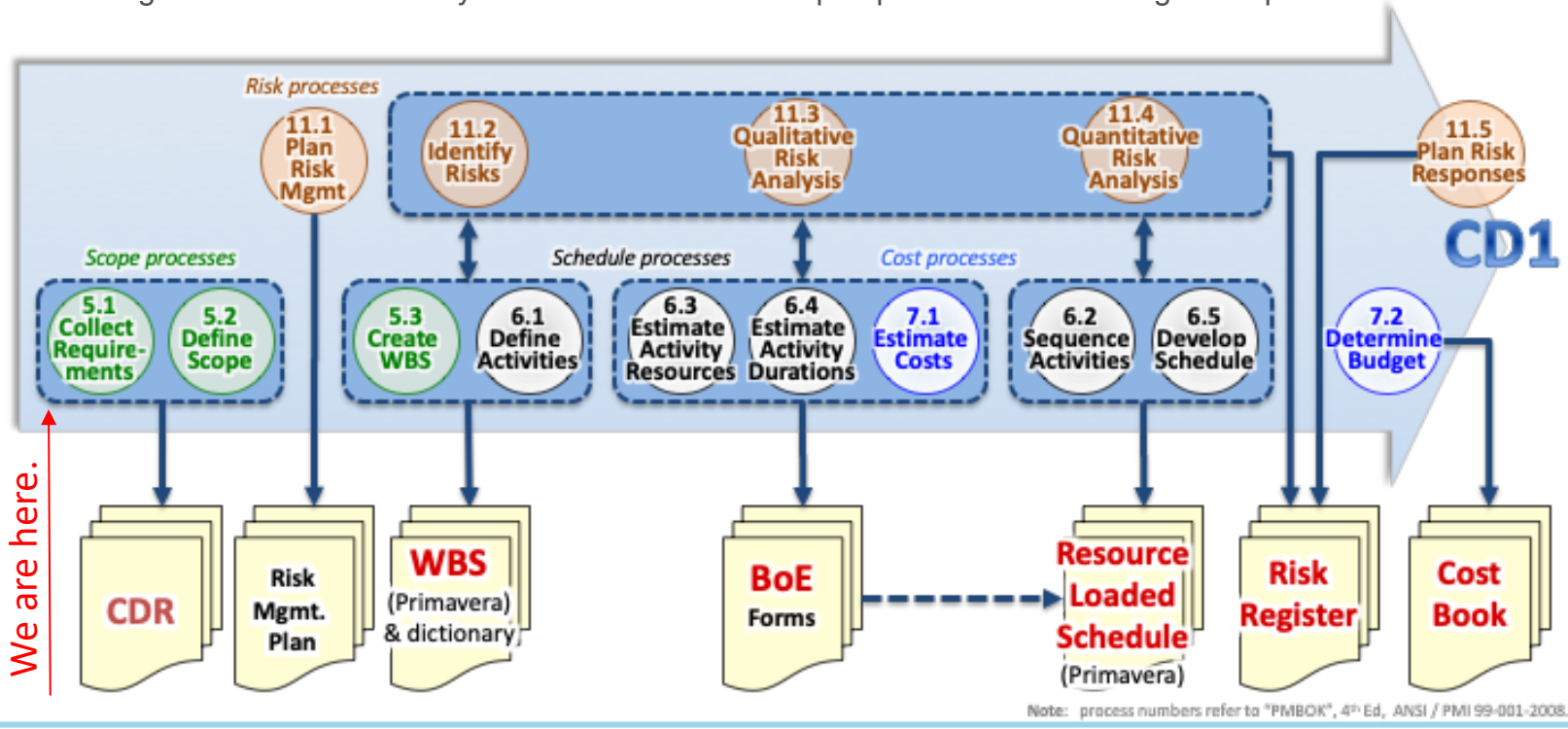
- The ACORN Project will modernize the **accelerator control system** and replace end-of-life **accelerator power supplies** to enable future operations of the Fermilab Accelerator Complex with megawatt particle beams.
- Critical Decision 0 (CD-0*) for the ACORN project was approved by DOE on August 28, 2020.
- We are planning for CD-1 (see next slide) by the second quarter of fiscal year 2022.

Chris Fall visits Fermilab and hears about the ACORN Project outside the Main Control Room, September 2020

* CD-0 documents that a mission need, such as a scientific goal or a new capability, requiring material investment exists. The mission need does not necessarily specify the facility, technology, or configuration of the project though these things are often described at some level.

Next Step for ACORN is CD-1*

* CD-1 serves as a determination that the selected alternative and approach is optimized to meet the mission need defined at CD-0. Key elements of the evaluation are the project's conceptual design, cost and schedule range, and general acquisition approach. The cost range allows for uncertainty in the estimates and scope options such as a range of capabilities.



(5.1) Collect Requirements to Define ACORN Project Scope

The project team will collect requirements by organizing workshops and interviewing people from around the lab and other accelerator labs.

Five high-level use cases define the project scope:

- Accelerator operations (e.g. accelerator complex, future PIP-II operations)
- Accelerator R&D (e.g. accelerator & beam physics, AI/ML capabilities)
- ES&H
- Experiment operations (e.g. DUNE, NOvA, Mu2e, SBN)
- Project interfaces (LBNF/DUNE, PIP-II)

In the next few months, the ACORN team will interview people to make sure all stakeholders are heard. We estimate 100 or more interviews to collect requirements.

Partnership Established with Idaho National Laboratory

Purpose:

Determine user interface (UI) requirements by analyzing accelerator operator, engineer and experimenter interactions with the accelerator control system. The objective is to analyze user needs in order to design an intuitive and easy to use UI for the control system.

INL Idaho National Laboratory

INL human factors experts have extensive experience designing user interfaces for safety-critical systems with complex user needs.

Recent Project Activities (Hiring and Subcontracting)

Hiring:

Three people were hired in January to join the core project team:

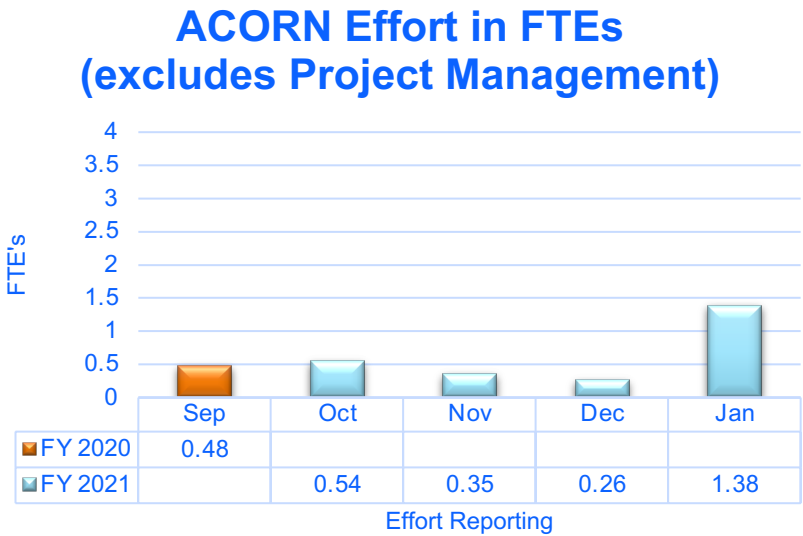
- Project Manager Associate (50% effort on ACORN)
- Software Architect
- Software Engineer

Subcontracting:

- Human Factors experts from Idaho National Laboratory (INL) joined the team in January.

Job opening later this year:

- Computer scientist with at least 6 years of AI/ML research experience.



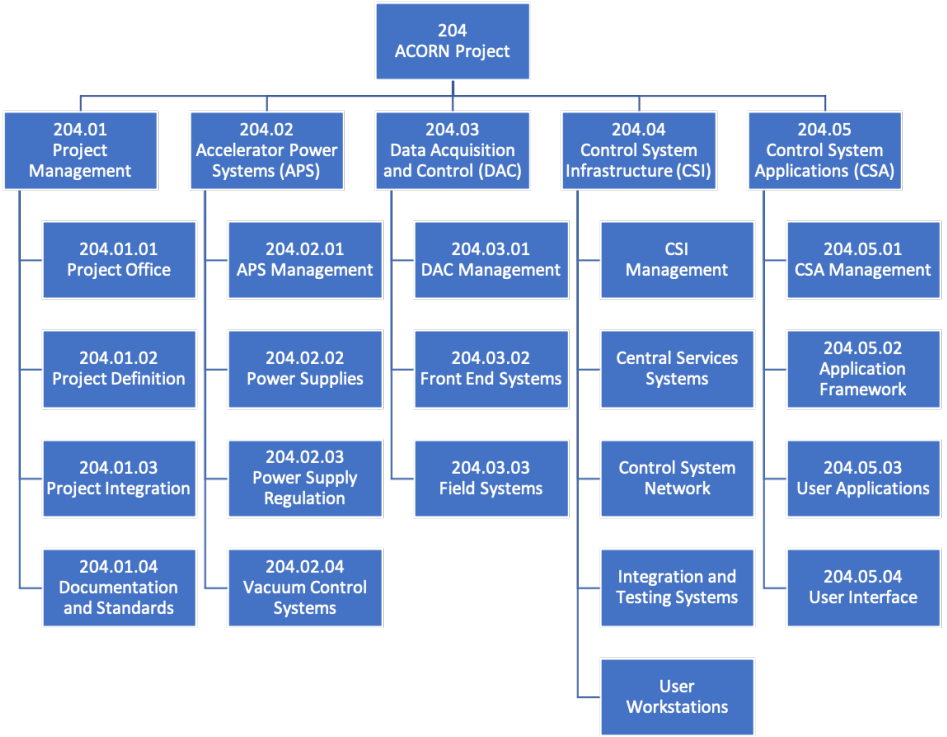
Project Management Opportunities

The project has a draft Work Breakdown Structure (WBS) that defines the project scope and project roles.

- Level 2 managers – 4
- Level 3 managers – ~15

Most project roles need to be filled:

- Deputy project manager
- L2 and L3 managers
- Control account managers
- Systems integration
- And others...



ACORN R&D Opportunities

Current R&D:

- Evaluate the feasibility of operating 5G mmWave wireless technology in accelerator tunnels. Our studies will evaluate the effects of tunnel curvature, radiation, RF and magnetic fields on 5G technology.
- Assess control and monitoring of 5G-enabled instrumentation (e.g. tunnel robots).

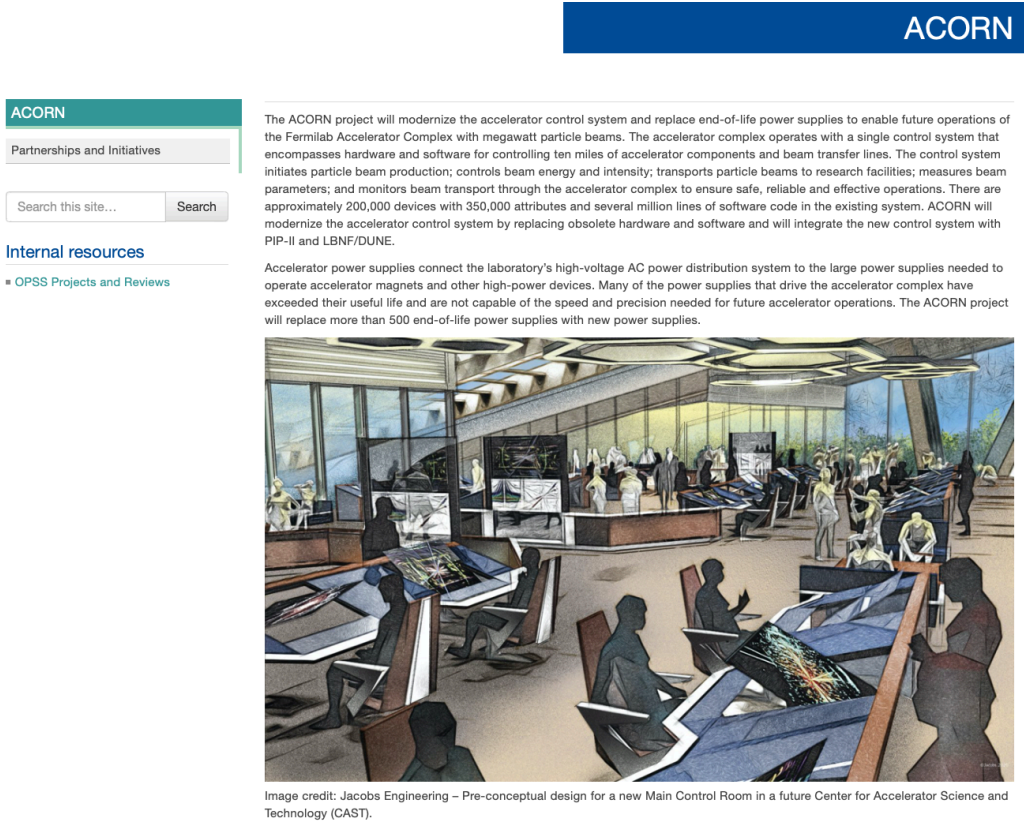
Future R&D (beginning in Oct. 2021):

- Artificial Intelligence / Machine Learning applications for accelerator operations
- Control system hardware and software (e.g. EPICS)
- Data acquisition systems
- Power regulation systems

Website Under Development (https://acorn.fnal.gov)

Future website content:

- ACORN R&D
- Job openings
- Project status
- Project news
- Integration with PIP-II and LBNF/DUNE
- Collaboration website



Summary

- CD-0 was approved August 28, 2020.
- The project team is planning for CD-1 in one year (second quarter of FY 22).
- First meeting of the project team one month ago. Effort is ramping up quickly.
- The team will focus on interviews and workshops to develop control system and power supply requirements and to make sure all stakeholders are heard.
- Most of the project roles (deputy PM, L2/L3 and control account managers) need to be filled in the coming months.
- Planning for ACORN R&D activities will begin in a few months with R&D funding expected in Oct. 2021.