# FERMI NATIONAL ACCELERATOR LABORATORY

# ACCELERATOR MAINTENANCE

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Fermilab is a U.S Department of Energy (DOE) research laboratory, operated under DOE contract by Universities Research Association (URA).

*Abstract*

Fermilab has two-hour necessary repair periods, 8 to 12 hour shutdowns, and multi-week shutdowns. The problem of any shutdown is how to communicate the goals and plans, how to coordinate the work, and how to ensure that only approved work gets done. This paper addresses the aspects of coordinating, communicating, planning, and controlling shutdowns, and the role Operations plays in these activities.

## RUN IT TILL SHE BLOWS

This is the philosophy of accelerator operation at Fermilab. In general we do not schedule repetitive shutdowns. Instead, we wait until something triggers a shutdown.

Here are a few examples of triggers:

- Equipment failures
- When the broken equipment list becomes large enough
- Necessary upgrades
- The experiments need an access

In order to make this system work, the Operations Department must keep an up-to-date set of work-lists in preparation for any triggered shutdown.

## MAINTENANCE SCHEDULES

One of Fermilab's greatest strengths is that of being extremely flexible. A fixed schedule is never allowed to get in the way of doing the right thing.

However, Fermilab's greatest weakness is that of being extremely flexible. Flexibility opens schedules up to pressures, whining, and whims. Everyone has an opinion and thinks their plan is the only one that is correct.

Trying to balance out these two opposites requires knowledgeable decision makers who possess the strength of will to stand by their decisions.

## SCHEDULE CONTROLS

The problem with controlling this type of maintenance system boils down to ensuring that people, who are just trying to be responsible about their systems, don't get carried away. How does it work?

- First, our people are very responsible. They use every opportunity to check and adjust their systems so that they cause no down time. However, during a shutdown they want to do too much. So we like to remind everyone that, **"If it ain't broke, don't fix it!"**

In Fermilab's realm of schedules,

**One Size Does Not Fit All.**

## TYPES OF ACCESS

Fermilab has two types of access.

### *Controlled Access*

- The tunnel interlocks have not been dropped.
- The tunnel requires no search and secure.
- Usually, this type of access has limits imposed on the amount of personnel and time of access.

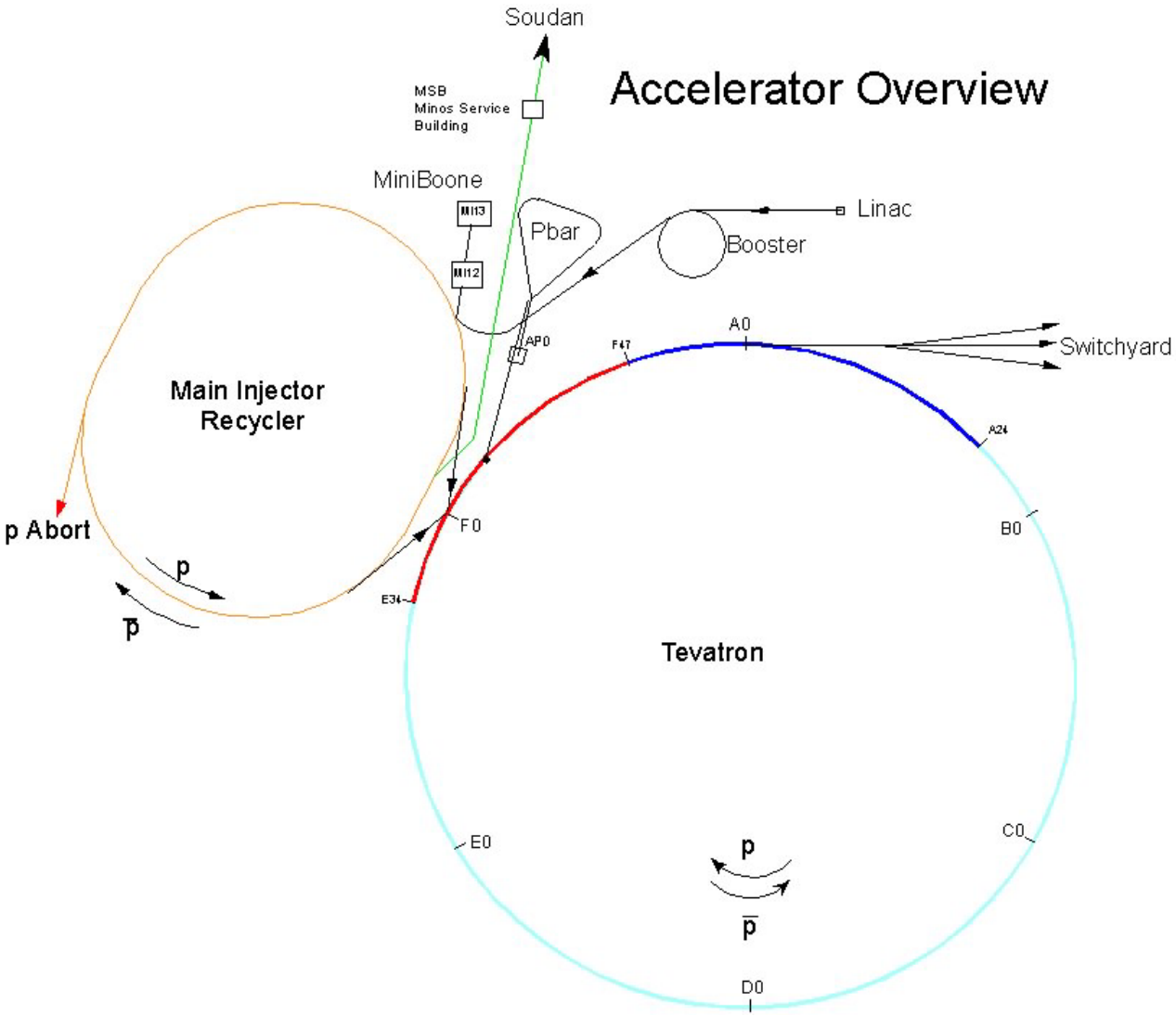
### *Supervised Access*

- The tunnel interlock system has been dropped. Operators must search and secure the area.
- Radiation technicians must perform a radiation survey of the tunnel. This means that beam must be turned off for several hours before performing the survey.
- An example of the downtime required for an eight-hour shut down would be shutting the beam off at 0500 hours (5 AM) and starting to turn things back on at 2000 hours (8 PM). This is a total of fifteen hours down for an eight-hour shutdown.

## COORDINATION MEETINGS

Keeping the castle walls from being stolen requires good communication.

- The Run Coordinator holds 0900 hours meetings every Monday, Wednesday, and Friday. The Crew Chief, experiment representatives, and Machine Coordinators report on accelerator operations.
- The Run Coordinator holds 1030 hours study meeting. This meeting is attended by Machine Coordinators and other associated people.
- Impromptu meetings of people bumping into each other are always being held in tunnels, collision halls, or parking lots.
- Both the Crew Chief and the Run Coordinator have regular phone meeting with each other, with Machine Coordinators, and with the people doing the work.
- The Environmental, Safety, and Health group review all proposed work.




## TYPES OF SHUTDOWNS

### *Equipment Failures*

Here is a list of things that Fermilab keeps in mind during an equipment failure.

1. Trigger Examples
   - An unknown failure occurs. Send experts to investigate and wait for an estimate before doing anything else.
   - If the failure is known, such as a Tevatron high-field quench, then there will be a minimum downtime of one hour. Then the question arises, can anything be accomplished during the recovery, like?

     a. Fix other problems
     b. Conduct accelerator studies
     c. Do nothing

2. Decision Makers
   - Crew Chief
   - Run Coordinator
   - Operations Management (sometimes)
3. Pressure
   - Necessary Repair Lists
   - Machine Coordinators
   - Department Heads
   - Key Support Department Personnel
4. Tricks
   2. If there is some special trick that can fix this problem, don't spread the word until you have enough information to make a decision.
5. Access Type
   3. Try to keep the access controlled.

### *Short Shutdowns*

What if the problem only requires a short shutdown of two hours or less? Here's how it may go.

1. Trigger Examples
   - A pump is making strange noises. Experts suggest replacing it within the next twenty-four hours.
   - In this situation we will look for "a window of opportunity."
2. Decision Makers

- Run Coordinator
- Operations Management
- ES&H (possibly)

3. Pressure
   - The 0900 hours meeting on Monday, Wednesday, and Friday.
   - What's the potential for failure?
   - Machine Coordinators
   - Department Heads
4. Tricks
   - Try scheduling a noon repair. (You will quickly discover who wants the work done and when.)
   - The decision makers must limit the approved work and not let things get carried away.
5. Access Type
   - Keep the access controlled.

### *Four Hour Shutdowns*

Here's where things may start getting serious.

1. Trigger Examples
   - Two Booster power amplifiers are down.
   - The experiments want a one-hour access.
   - A magnet needs a vacuum leak check.
   - Do we really need to go down? **NO!** However, if there is enough complaining going on we may shut down.
2. Decision Makers
   - Run Coordinator
   - Operations Management
   - ES&H (possibly)
3. Pressure
   - The 0900 hours meeting on Monday, Wednesday, and Friday.
   - What's the potential for failure?
   - Machine Coordinators
   - Department Heads
4. Tricks
   - At all costs, try to schedule this type of access for the beginning of the next day.
   - You need time to plan, and you need time to recover.
5. Access Type
   - This should be a controlled access, but the experiments frequently ask for supervised access.
   - This adds time because operators must conduct a search and secure before the start up can begin.

### *One or Two Day Shutdowns*

1. Trigger Examples
   - The work list has grown large.
   - A new collimator and shielding is ready for installation in the Booster.
2. Decision Makers
   - Run Coordinator
   - Division Head guidance
   - Program Planning guidance
   - Operations Management
   - ES&H
   - Discussion for this type of access and easily begin up to one month ahead of time, or in reality at least a week a head of time.
3. Pressure
   - The 0900 hours meeting on Monday, Wednesday, and Friday.
   - What's the potential for failure?
   - Machine Coordinators
   - Department Heads
   - Division Head
4. Tricks
   - At all costs, try not to schedule this shutdown just before a weekend.
   - Schedule this work to begin at the beginning of the day shift.
   - Schedule this shutdown to begin on a Wednesday. It give you time to plan.
   - Understand that the machine will require time to recover.
5. Access Type
   - For a one-day access, try to keep the access controlled, but there will be pressure for one day of supervised access.
   - If it's a two day access, there will be even more pressure to go to a supervised access.
   - A supervised access means that time must be allotted for interlocking areas.

### *A Shutdown of One Week or Greater*

1. Trigger Examples
   - Budget Concerns
   - Long range upgrades
   - In the past we've made shutdown decisions due to a coal strike and to nitrogen delivery problems. (The coal strike probably needs a little explanation. One particularly cold winter there was a coal strike. This should not have been a problem to coal fired electrical generators, except that it was so cold that the piles of surplus coal were frozen. The Department of Energy called Fermilab and asked them to shut down.)
2. Decision Makers
   - Lab Director
   - Division Head
   - Run II strategy meeting
   - Run Coordinator
   - Operations Management
3. Pressure
   - Division Head and Lab Management
   - Department Heads
   - Much heated discussion
4. Tricks

- Assign a shutdown coordinator.
- This schedule is generally planned out several months in advance and requires many meetings.
- You need to plan.
- You need time understand how much time you will need to recover.

5. Access Type
   - This is a supervised access.

### *Emergency Power Reduction Shutdowns or Power Outages*

1. Trigger Examples
   - There is a problem with the local power grid.
     a. When there's a problem with a local grid, the power reduction usually occurs between noon and 2000 hours.
     b. The power company must give a 24-hour warning.
     c. There is a cost savings for the laboratory, which is announced the day before.
     d. The power company and the laboratory discuss the amount of power reduction the day before it is to occur, such as reducing our normal usage of 47 MW by 20 MW.
   - A kite string has draped over a power line.
   - Coal strike (see previous explanation)
   - Loss of a major power line insulator
2. Decision Makers
   - The Lab Director will make all decisions for the laboratory.
   - The normal decision makers must pick a shutdown coordinator.
   - The laboratory Power Coordinator (Operations Department) will implement power reduction policies working with a special power reduction team.
3. Pressure
   - **AT ALL COSTS KEEP THE CRYO SYSTEM UP AND RUNNING.**
4. The Shutdown Coordinator Responsibilities
   - Take advice from all the decision makers and then pick a tentative date for the shutdown at least six months ahead of time.
   - Take advice and the pick a "set in stone date" no later than one month ahead of time.
   - Figure out the shutdown's limiting factors.
     a. Length
     b. Manpower
        * Is the manpower available?
        * Outside lab temporary help?
        * Draft people from other departments and divisions?
     c. Other Pressures
4. Meetings — <u>Communication is Critical!</u>
   - The Division Head formally sets the tone for the shutdown.
   - Meet with Division Management so they can understand what is about to happen and set the scope of priorities.
   - Department Head meetings
   - Informal weekly meetings with those directly impacted by shutdown.
   - The 0900 hours meeting on Monday, Wednesday, and Friday.
   - Special shutdown meeting where work lists are analyzed.
   - Run II strategy meetings
   - During the shutdown there are daily or every other day meetings.
   - ES&H meeting to review work lists

## SUMMARY

**"Run it till she blows" works. It does give Fermilab more up time.**

**System and support departments must be organized ahead of time in order to use down time whenever it appears.**

**There must be strong decision making.**

**The Run Coordinator administers all decisions about beam operations.**

**A Shutdown Coordinator administers all decision about long shutdowns.**

**A Power Outage Coordinator administers all decisions about emergency power reductions.**

**The Accelerator Operations Department is heavily involved in all these activities.**

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