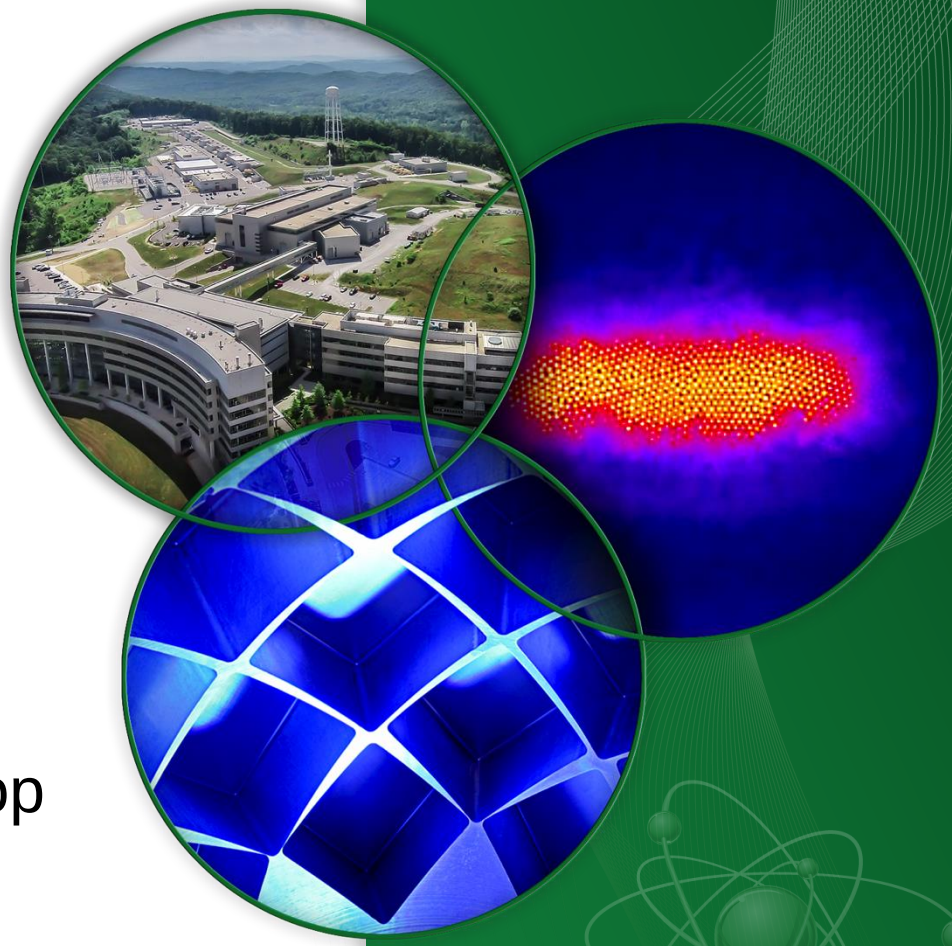
# Definition of Terms



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# What do we mean?

- Reliability – How long does the equipment perform its intended function before some kind of failure
- Availability – the percent of time that the equipment is in an operable state
- Predictability – the percent of time that the equipment is operable when your operations schedule shows that it should be operable

# Reliability

Reliability is a measure of the probability that an item will perform its intended function for a specified interval under stated conditions. There are two commonly used measures of reliability:

- Mean Time Between Failure (MTBF), which can crudely be thought of as the (total time in service / number of failures)*
- Failure Rate (λ), which is also crudely thought of as (number of failures / total time in service) *

* this is ONLY true for systems with a constant failure rate…. Don't make me drag out my Reliability Theory talk….

# Availability

Availability is an Operations parameter. If the equipment is available 85% of the time, we are producing at 85% of the equipment's technical limit. This usually equates to the overall performance of the asset. Of course quality of the product (beam) must be  to be considered in order to properly account for downtime*. Availability can be measured as: Uptime / Total Time (Uptime + Downtime).

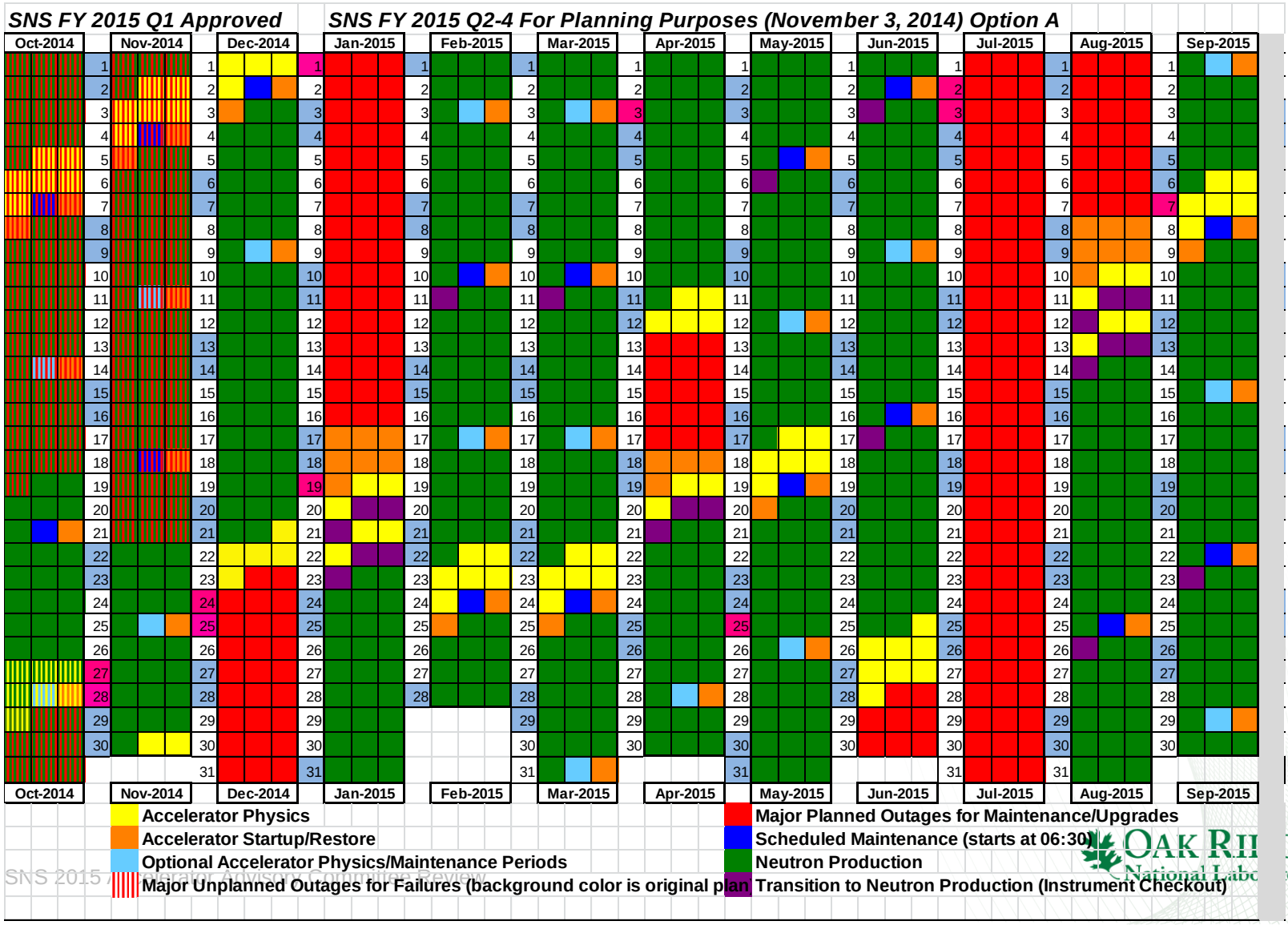
* If it takes an hour to restore beam of sufficient quality for the process e.g. data taking, then this is part of the downtime as well.

# Reliability and Availability

- A piece of equipment can be available but not reliable. For example the accelerator is down 6 minutes every hour. This translates into an availability of 90% but a reliability of less than 1 hour. If trip recovery is instantaneous, this is not so bad, but if the time to restore high quality beam is one hour, your beam availability would be 0.
- The SNS Has ~1,500 FPAR trips /week which truncate the pulse. These are all but invisible as there are 5.2M pulses per day. There are also ~300 FPL which require operator intervention(less than 1 minute). These are a background of ~2% downtime. The total SNS downtime is from events with longer than 20 minute recovery.
- Generally speaking a high reliability machine has high availability but an available machine may or may not be very reliable.

# Predictability

- Are you running when you say, in advance, that you will be running?



# Predictability

So, fixing the beam and running through a Maintenance Day gives the users the beamtime back but does not help the lost predictability. This is a big factor in short turnaround processes:

- Materials Science Experiments (1-3 days)
- Radiotherapy (patients waiting for treatment)

# Questions?