Some Like It Hot: Summer Running at RHIC

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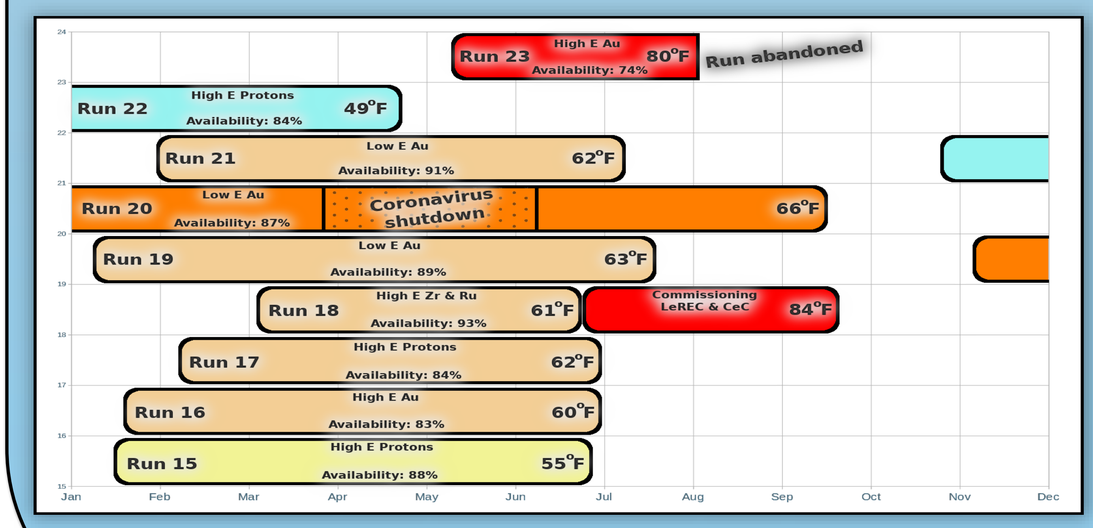
Background

"It is a truth universally acknowledged that RHIC should not run in the summer."
~not Jane Austin

Having run for 23 years now, we finally have experimental evidence to back up the above assertion. The first few runs at RHIC took place in the summer months. Following those, RHIC almost exclusively shut down for those periods. The reasons given were the cost of electricity, the potential impact on residential customers on the local grid, and the stability of the grid, particularly as a result of lightning strikes.

Runs 18 and 20 extended into the hotter weather of the summer. Runs 19 and 21 to a lesser extent. However, none of these runs involved ramping the RHIC mains and running power supplies at high setpoints. This was the nature of "Beam Energy Scan II"—running beam at varied low energies to try to examine the critical point of a quark-gluon plasma. The second half of run 18 involved no hadron beam at all, as it consisted solely of subsystem commissioning work.

The success of these runs may have led to a false sense of security and confidence about running in the heat of the summer. Run 23 disabused us of those notions.



A history of recent runs.

The Run

"Here are some who like to run. They run for fun in the hot, hot sun."
~Dr. Seuss

Run 23 began with a tougher-than-usual startup. Operations had not run in a mode like this since 2016, and only 1/3 of Main Control Room staff had ever done it before. Configuration changes, (expected) vacuum issues, and changing targets meant that a challenging startup was unavoidable.

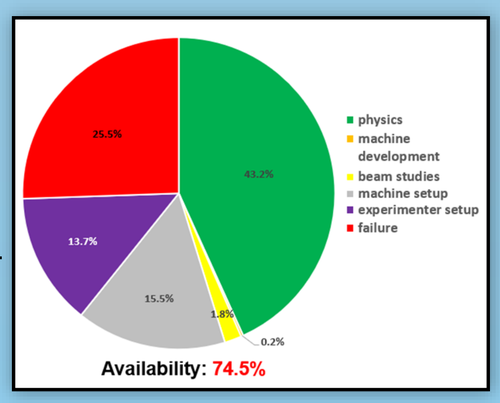
As the run continued, and temperatures began to rise, several buildings started to suffer as their A/C systems failed. One in particular--building 1004B--had parts on order with a **9 month** lead time. 1004B hosts the RHIC Main Magnet Power Supply. Those systems were almost exclusively the responsibility of **one staff member**.

Part-way through the run, the now-notorious Canadian wildfires impacted operations. The smoke was so intense that many of the smoke detectors across the Lab were expected to go off. In the case of the STAR Experiment, Fire Rescue required that its High Sensitivity Smoke Detector (HSSD) be disabled until the smoke dissipated. Procedure required that STAR cannot run without the HSSD, so it was shut down and locked out.

This was the first time a global climate change-influenced event shut down the program.

As more buildings overheated and parts were found to be unavailable, support teams found themselves opening doors and distributing fans. Sometimes pointing them directly at overheating FECs. It was well known to us that the FECs used in the quench detection system would "fail safe" and abruptly cut off the power supplies if they overheated. Others—for instance those involved in handling instrumentation—would at best go offline.

Every group found themselves in ever-increasing demand as their systems came under pressure and failure rates increased. E.g.: the proportion of downtime attributed to Power Supply failures tripled compared with previous runs. Run 22 saw 6 Power Supply replacements. Run 23 had 20.



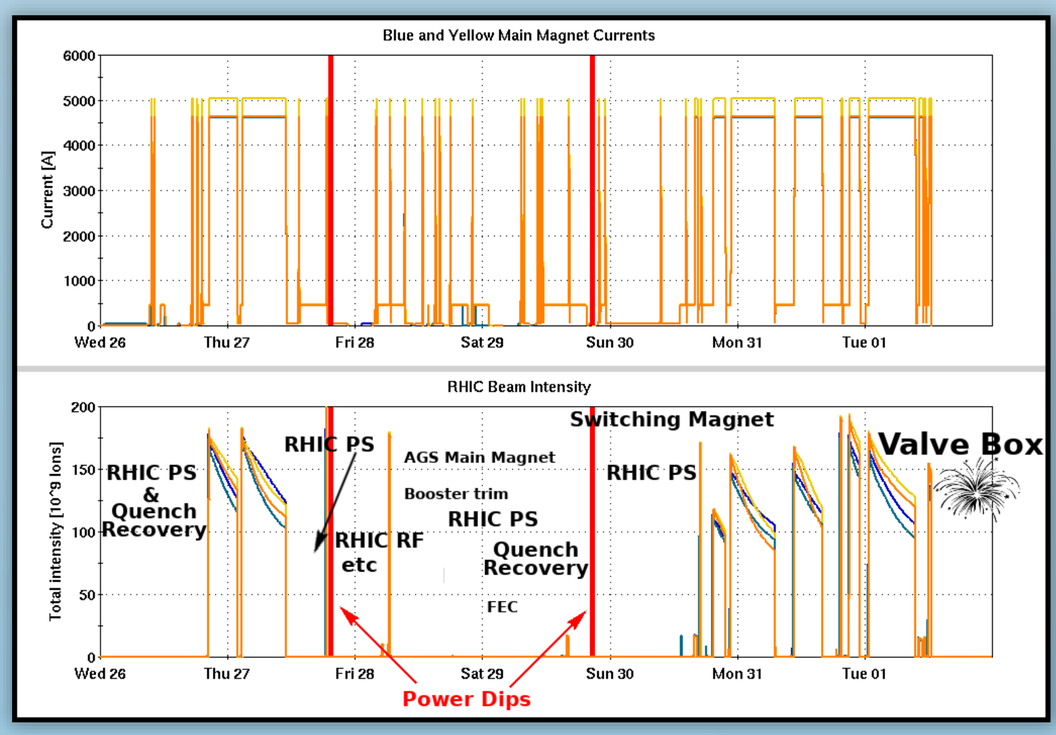
As the summer wore on, burn out became evident. Call-ins took longer. Fewer people with experience were available to help.

The program even began to stall as personnel availability suffered.

The Grand Finale

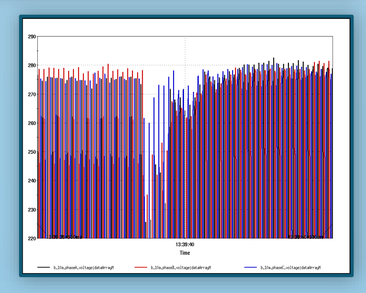
"This is the way the run ends/Not with a whimper but a bang."
~not T. S. Eliot

What was to become the final week of Run 23 began in warm weather. A power dip had already shut down most of the complex. It took a concerted effort by the RHIC PS Group to repair a mysterious fault that held off recovering the quench link.



Two stores went up unsuccessfully, only for another power supply failure to hit. Just as that was recovered in the evening, another massive power dip took out most of the complex.

A plethora of systems went down, critically including a major trim supply that was necessary for beam in the injector chain. A shortage of personnel meant beam in the injectors was held off for a whole night.



A typical power dip.

Behind all this many other systems went down, not just because of the power dip, but because of heat-related failures.

The switching magnet responsible for directing beam into either of the RHIC rings developed a water flow problem which became a control problem when a cable was broken during repair. Rested personnel were becoming hard to find.

A second power dip took down many more systems, leading the week to be dubbed "worst week ever."

Recovery on Monday seemed to hold until a QLI caused heaters to fire and a valve box in 1004B to break and vent nearly the whole blue ring's worth of Helium.

As our Run Coordinator put it "At least 1004B is cool now."

Lessons Learned and Plans for the Future

"The time to repair the Air Conditioning is not when the sun is already shining."
~not John F. Kennedy

The challenges of run 23 have provided some valuable insights. These have led to some varied proposals for how C-AD moves forward.

- High temperature stand-downs. C-AD already has a policy for stand-downs during lightning storms. A working group to establish a suitable ambient temperature to trigger a general stand-down can be set up.
- Standardize AC/Cooling equipment when making replacements. Keep spares available when possible. Interchangeability between systems should be a goal.
- Ad-hoc cooling. At present we are limited to a few units and a slew of fans. Support teams need more options than "point a fan at it."
- Investigate enhanced protection against power instabilities for all systems.
- Personnel. This run showed more strain on personnel than expected. Some staff were run ragged. Identify groups where this is a risk and either hire additional personnel or cross-train.
- **Don't run in the summer.**

Considering the construction of the EIC, these lessons learned and proposals should be folded into the project planning. It would be unacceptable to build a new collider with cooling equipment that had 9-month lead times for replacement components.

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