
# Lessons Learned From E7 at LIGO Hanford Observatory

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# The Next-to-Bottom Line: Duty Cycle

| Configuration | Duty Cycle Locked | Duty Cycle Locked > 15 min |
|---|---|---|
| 3-IFO | 34.5% | 17.6% |
| L1 | 70.7% | 62% |
| H1 | 72% | 56.6% |
| H2 | 52.5% | 38.5% |


# Limitations to Duty Cycle

- H2 Exhibited Large Variation in Availability
  - » Produced long locked sections for most of first 10 days during non-construction hours. Up to 7.5 hours! Twice!
  - » Lost significant time (> 1 shift) to CDS crashes on two occasions
  - » Following 2nd crash we never had good availability for rest of E7
  - » Reasons for this poor performance period have not been found
  - » Much of data plagued by MICH_CTRL bursts
- H1 Had Far Less Actuation Range in DSC
  - » More susceptible to seismic environment, control glitches
  - » Fine actuators often ran out of range for tidal control
  - » Thus locked sections typically shorter, but kept on running and produced more data for searches, but lousy strain spectrum


# Operational Lessons

- Scientists and operators agree that no one likes 12-hr shifts
- Frequent phone contacts between control rooms worked well to optimize up time between sites
- Daily teleconferences between sites did not seem that helpful
- Need better script – but at least there was one
  - » Minimal intervention to preserve data quality was uniformly understood direction, but interpretation varied shift to shift
  - » We can write better directions next time, but daily review & revision may be needed – topic for daily telecon?


# Needs Exposed by E7

- "Expert" science monitors should have expertise; advise more LSC participation in commissioning
- Operator expertise is varied – need more uniformity to always have similar capability on hand
- Need troubleshooting guide to indicate when and how to intervene and when not to intervene
- Need better way to avoid "configuration drift"
- Some DMT monitors need more user-friendly interfaces and better transparency; e.g.,few people could tell if monitors were *working* as opposed to *running*

# Largest need is for better control room monitoring of data quality

- We had very good visibility from control room into when locked data was accumulating at either observatory using DMT lock monitor
- Had poor idea of data quality (the bottom line!)
  - » Example: intervened at lock onset when H2 MICH_CTRL was too “bursty” and threatening lock durations, but did not know if burst search quality was improved or degraded by intervention!
- Need some data analysis monitors viewable from control room to really get hands on data quality
- Need on-line LDAS visibility and intervention capability in control room to restart stalled jobs.


# Commissioning Benefits of E7

- Long running times in relatively constant configuration gave unique commissioning opportunity
  - » Tidal compensation thru fine actuator proved a success on 2K IFO and provided useful data to solve for perturbative corrections to tidal model
  - » Tidal compensation thru fine actuator was successful on 4K IFO, until tides exceeded fine actuator range as expected
  - » Confirmed that microseism at high excitation can exceed range on 4K digital suspension controllers without feedforward compensation
  - » Valuable lock loss data – e.g., found MICH_CTRL bursts a killer on recycled 2K interferometer


# Overall Evaluation

- Run cost approximately a month of schedule – expensive, so need to learn without too many iterations!
- Duty cycle was impressive, given lack of time to emphasize lock stability in preparations for E7
- Some LSC Detector Characterization deliverables were delivered and used in control room
- On-line analysis system worked impressively in first real trial
- Sensitivity was poor, as expected, but will serve to give LSC data-analysis people a look at something closer to reality
- Provided opportunity for LSC participation; maybe some will become interested in larger commissioning role?
- Long running times gave special window for commissioning
- We have some experience under our belts