# ATWS-I Rod Bundle Tests UNR

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# Overview

- Steady State Testing:
  Considers variation in flow, pressure, subcooling, and power – Used to determine empirical quantities (critical power and spacer losses)
- Transient Testing:
  Considers variation in power, level, subcooling, fuel thermal time constant, hysteresis, and feedback coefficient – Used to determine conditions leading to failure to rewet

# Testing Schedule

- Pre-insertion assembly witnessing test:
  August 1-3, 2016.
- Steady-state testing:
  August 8-15, 2016.
- Transient testing:
  August 29-September 12, 2016.
- Final testing data transfer:
  September 26, 2016.
- Documentation of the final testing:
  4$^{th}$ quarter CY 2016.

# Test Matrix without Feedback

| Test No. | Pressure bar | Inlet Subcooling K | Initial Power MW | Water Level |
|---|---|---|---|---|
| 1 | 70 | 20.0 | 3.0 | Nominal |
| 2 | 70 | 20.0 | 3.0 | Reduced |
| 3 | 70 | 45.0 | 3.0 | Nominal |
| 4 | 80 | 20.0 | 3.0 | Nominal |

# Test Matrix with Feedback

| Feedback | | Pressure (bar) | Fuel thermal Time Constant | Expected DR | | Oscillation Magnitude | | Record | Comments |
|---|---|---|---|---|---|---|---|---|---|
|  | gain | | | Hyd. | System | Flow% | Power% | Time [min] | |
| 0 | 0 | 70 | 2.5 | 0.5 | - | Noise | Noise | 10 | |
| | Small | | | 0.5 | <1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | ~1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | | | | | | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | | | | | | Decay | | 2 | |
| 0 | 0 | 80 | 2.5 | 0.5 | - | Noise | Noise | 10 | |
| | Small | | | 0.5 | <1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | ~1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | | | | | | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | | | | | | Decay | | 2 | |
| 1.0 | Same | 70 | 2.5 | 0.5 | <1.0 | Noise | Noise | 10 | |
| | Increase | | | 0.5 | ~1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | >1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | Increase | | | 0.5 | >1.0 | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | 0 | | | 0.5 | - | Decay | | 2 | |
| 0.8 | Same | 70 | 2.5 | 0.5 | <1.0 | Noise | Noise | 10 | |
| | Increase | | | 0.5 | ~1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | >1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | Increase | | | 0.5 | >1.0 | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | 0 | | | 0.5 | - | Decay | | 2 | |

# Test Matrix with Feedback (continued)

| Feedback | | Pressure (bar) | Fuel thermal Time Constant | Expected DR | | Oscillation Magnitude | | Record | Comments |
|---|---|---|---|---|---|---|---|---|---|
|  | gain | | | Hyd. | System | Flow% | Power% | Time [min] | |
| 1.2 | Same | 70 | 2.5 | 0.5 | <1.0 | Noise | Noise | 10 | |
| | Increase | | | 0.5 | ~1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | >1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | Increase | | | 0.5 | >1.0 | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | 0 | | | 0.5 | - | Decay | | 2 | |
| 0.0 | Same | 70 | 2.0 | 0.5 | <1.0 | Noise | Noise | 10 | |
| | Increase | | | 0.5 | ~1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | >1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | Increase | | | 0.5 | >1.0 | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | 0 | | | 0.5 | - | Decay | | 2 | |
| 0.0 | Same | 70 | 4.0 | 0.5 | <1.0 | Noise | Noise | 10 | |
| | Increase | | | 0.5 | ~1.0 | Coherent | Coherent | 3 | |
| | Increase | | | 0.5 | >1.0 | 20% | | 3 | |
| | Increase | | | 0.5 | >1.0 | Large | | 1 | Dryout inception |
| | Increase | | | 0.5 | >1.0 | Large | | Short | Dryout/rewetting, ΔT< 100 K |
| | 0 | | | 0.5 | - | Decay | | 2 | |

# Questions?