Drill Rig Technical Review Status

By
Deana Huff and Alan Schuler
Alaska Department of Environmental Conservation
Air Division Staff
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Where Are We At?

- Industry provided 1-hour NO_2 modeling files in September 2014
- ADEC staff questioned following aspects
  - Monte Carlo assumptions
  - Assumed stack heights

(assuming AEROMD input files are acceptable)

1) Are 10,000 simulations adequate?
2) Are the results precise?
3) Are the distribution parameters conservatively representative?

Table 1: TRANSVAP Results Varying Number of Simulations (Infill Drilling)

Simulations	Design Concentrations (mg/m^3)						
	Max	Avg	50th	75th	90th	95th	99th
100	57.25	27.92	27.47	32.66	39.37	48.32	52.48
500	60.11	28.43	28.19	34.33	41.94	47.15	54.78
1000	64.12	28.23	27.88	34.05	41.38	45.67	54.78
2500	68.44	27.73	27.16	33.78	40.78	44.88	55.16
5000	75.82	27.72	27.20	33.82	40.35	44.86	54.74
7500	75.82	27.64	27.15	33.75	40.33	44.71	55.07
10000	76.19	27.59	27.12	33.76	40.22	44.79	55.30

NOTE: All runs were conducted using the same TRANSVAP simulation input file that was reduced from 10,000 simulations to the appropriate number. All runs were conducted with 12,000 gal/day fuel use.

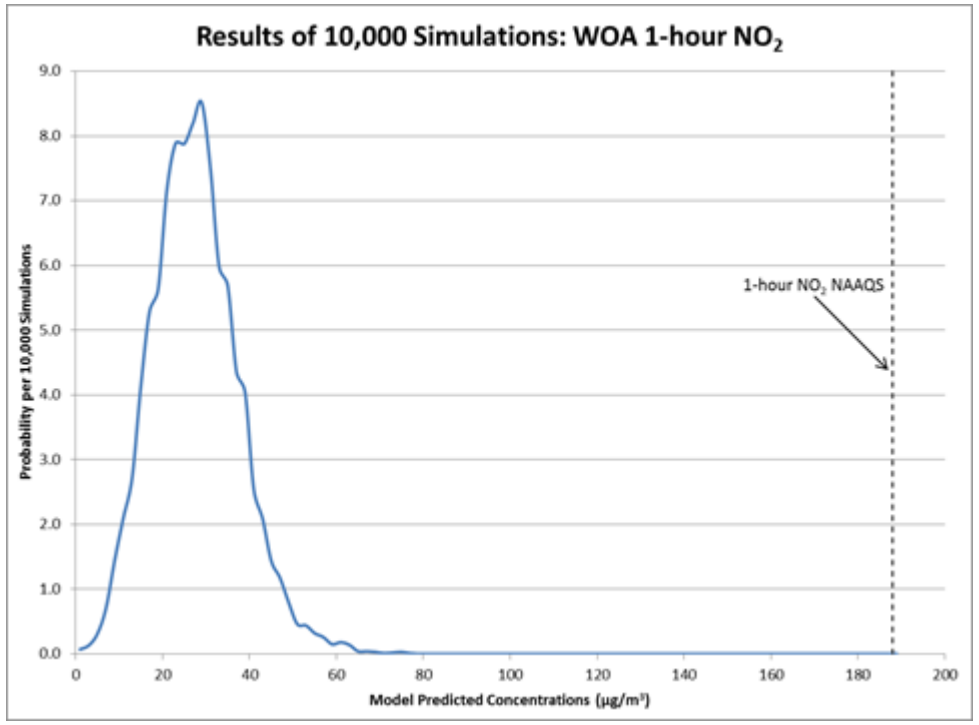


Figure 1: Frequency Distribution of TRANSVAP Run (Infill Drilling) with 10,000 Simulations (Data summarized in Table 1)

Table 2: TRANSVAP Results Varying the Randomly Generated TRANSVAP Simulation Input File (Infill Drilling)

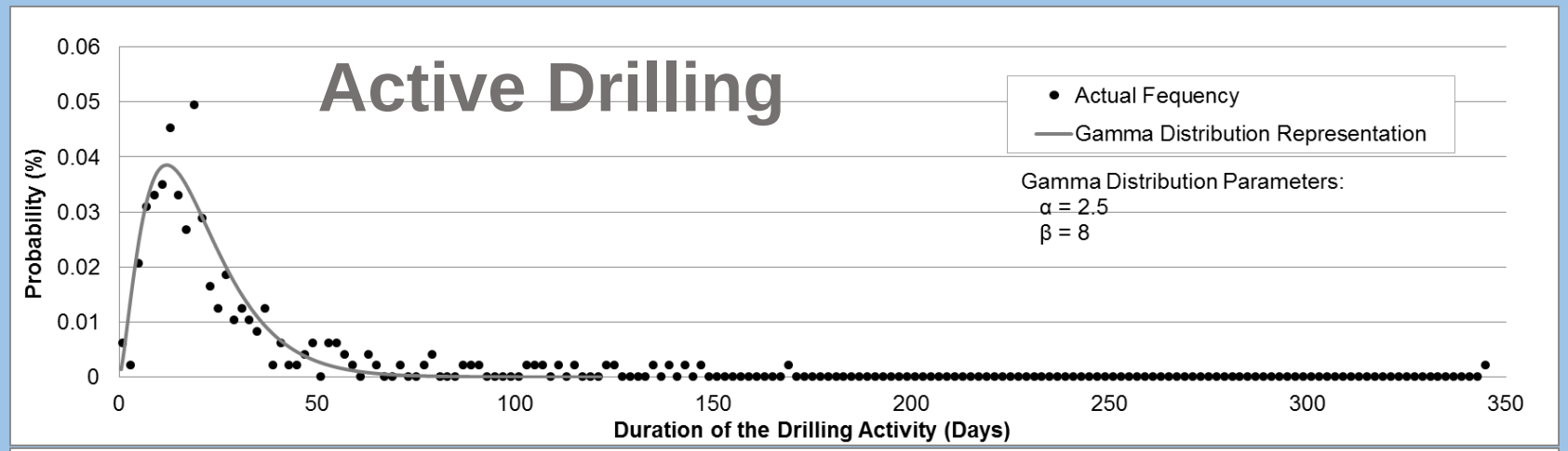
File	Design Concentrations (mg/m^3)						
	Max	Avg	50th	75th	90th	95th	99th
1 (Original)	76.19	27.59	27.12	33.76	40.22	44.79	55.30
2	72.95	27.26	26.85	33.22	39.76	43.89	53.15
3	88.67	27.30	26.90	33.36	39.95	44.64	54.60
4	81.95	27.34	26.91	33.23	39.41	44.06	54.38
5	75.51	27.32	26.72	33.16	39.86	44.37	54.80
6	74.19	27.24	26.86	33.09	39.62	43.66	53.74
7	74.92	27.21	26.73	33.32	39.92	44.10	53.62
8	81.34	27.37	26.83	33.52	39.80	44.33	55.56
9	86.47	27.35	27.02	33.23	39.81	44.11	52.99
10	79.75	27.16	26.81	33.06	39.65	43.89	52.39
Minimum	72.95	27.16	26.72	33.06	39.41	43.66	52.39
Maximum	88.67	27.59	27.12	33.76	40.22	44.79	55.56
Range	15.72	0.44	0.41	0.70	0.81	1.13	3.17
Average	79.19	27.31	26.87	33.30	39.80	44.18	54.05
Std Dev	5.38	0.12	0.12	0.21	0.22	0.35	1.04

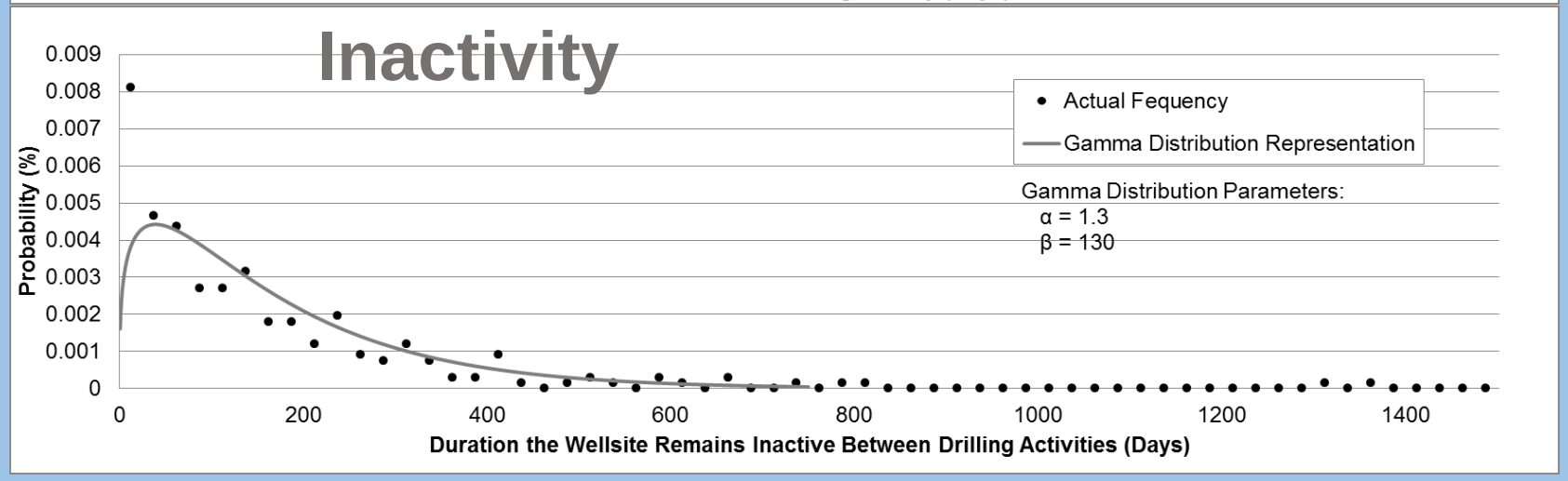
NOTE: Different TRANSVAP simulation input files were generated for each run. All runs were conducted with 12,000 gal/day fuel use and 10,000 simulations. File 1 (Original) is the same file that was used for 10,000 simulations in Table 1.

Tables and plot presented in email by AECOM

Are the distribution parameters conservatively representative?

RDi: Representative Routine Drill Rig Activity Profiles





Presented at Drill Rig Policy Working Group by AECOM

Are the distribution parameters conservatively representative?

Overview of Proposed Acceptable Operation for the ANS No Electrification - Based on Modeling (TRANSVAP)

Active Drilling Profile	Inactive Drilling Profile	%tile	Nominal Fuel Consumption	
			RDi (gal/day)	RDc (gal/day)
Gamma Distribution Initial Proposal	**Gamma Distribution** Initial Proposal	100th	20,300	15,400
		99th	28,900	22,100
Lognormal Distribution Distribution Parameters from Mean and Standard Deviation of Data	**Gamma Distribution** Maximum Likelihood Fit (R)	100th	13,100	9,700
		99th	20,600	15,600

ANS = A-Pad Met. – Alaska North Slope

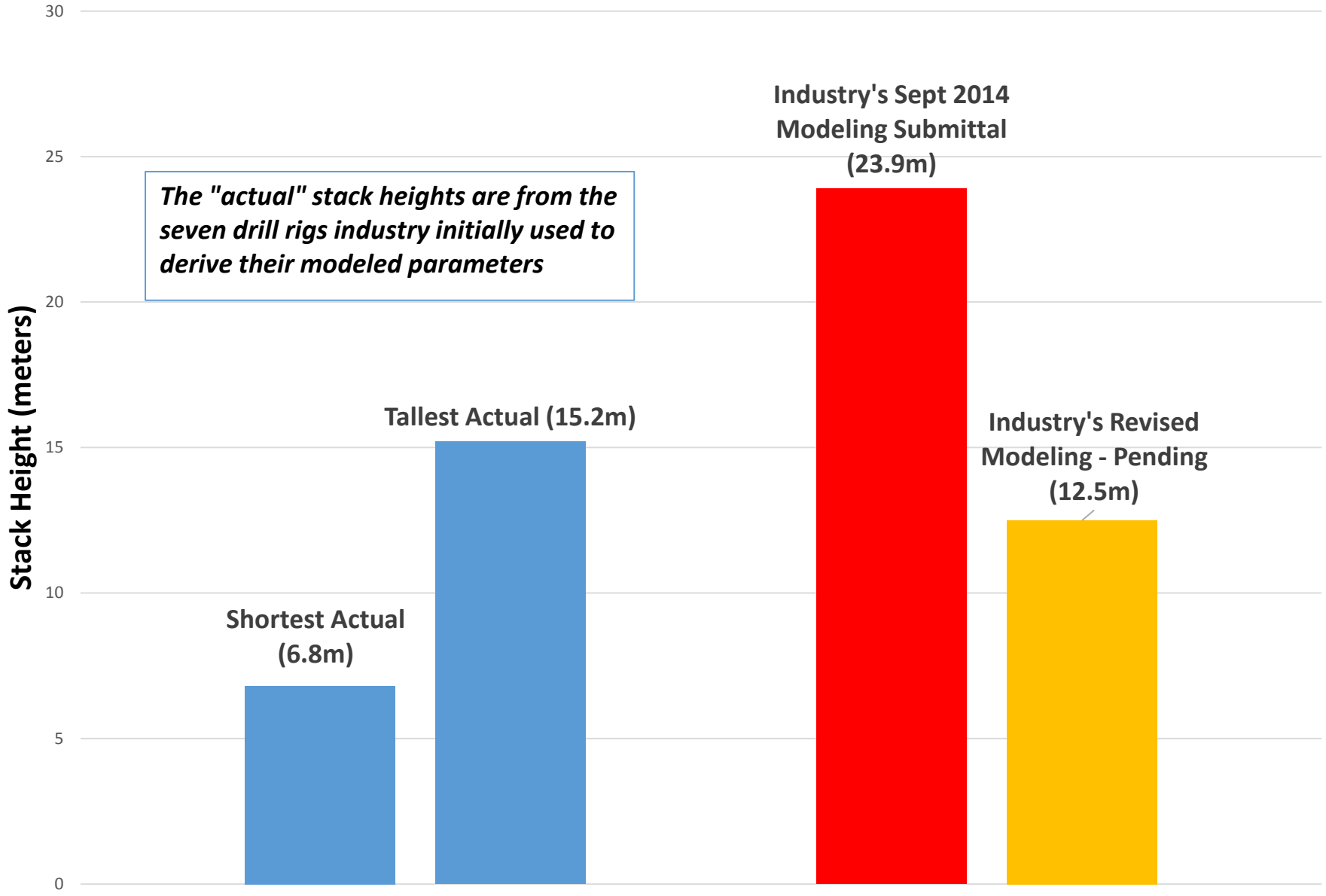
- **Nominal Fuel Consumption ≠ Not-to-Exceed:**
  - Modeling indicates random excursions above nominal do not significantly impact conclusions.

Presented by AECOM as a TRANSVAP Update

Staff Concerns re Stack Heights

- Industry used seven drill rigs to update the Department's MG1 stack height/building height ratios
  - Using a representative stack height to building height ratio is warranted, *but*
  - Industry did not update other aspects of "the equation"
  - Used MG1 building height to calculate the stack heights
- Lead to revised, but questionable, stack heights (see following figure)

Comparison of Primary Engine Stack Heights

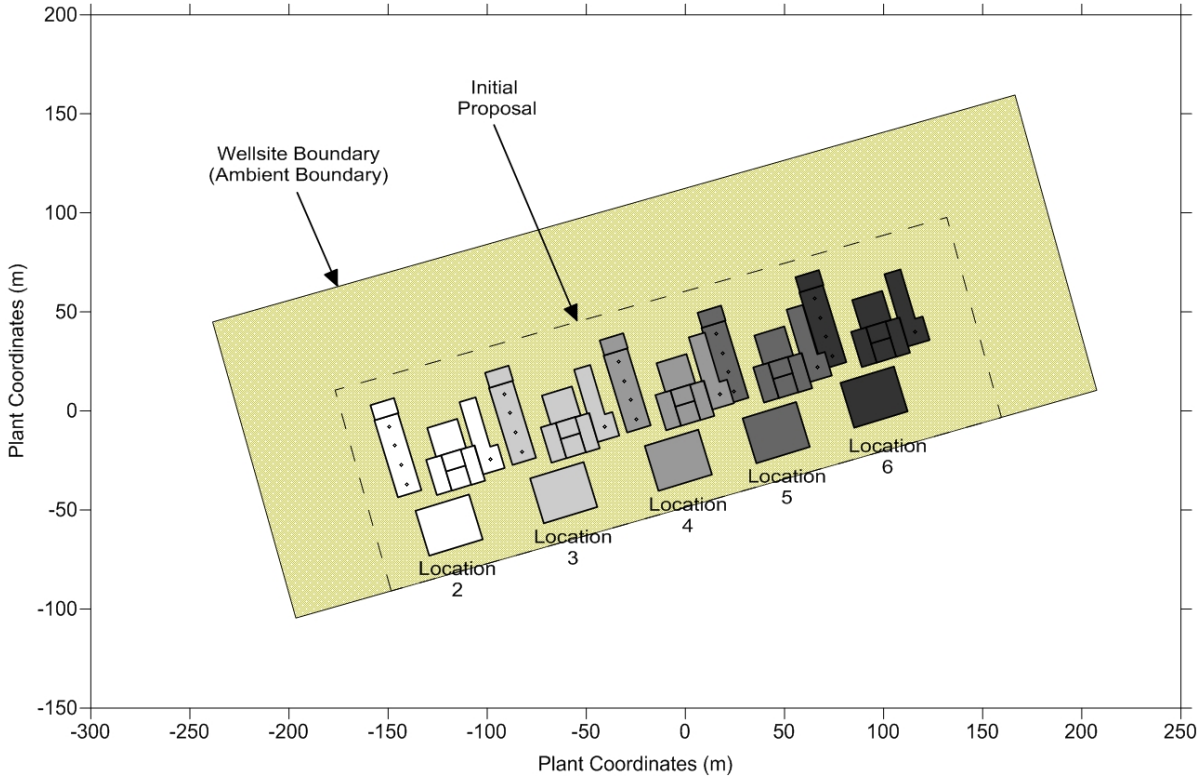


Stack Concerns (cont'd)

- Industry shortened stack/building heights in response to staff comments
  - Industry said change lead to increased impacts/substantially smaller fuel limits
- Industry then revised additional aspects of North Slope analysis
  - Increased pad size (see following figure)
  - Altered other stack assumptions
    - No collocated stacks
    - Lowered in-stack NO2/NOx ratios
- Industry has not yet provided revised modeling files to ADEC
- Said reducing the conservative nature of previous analysis lead to fairly similar fuel limits as originally found

Reducing Conservatism - Revised Pad Boundary

- The pad boundary was extended 50-m on three sides. This is larger than the smallest Alpine pads (CD4), representative of a larger Alpine or Kuparuk Pad, but still smaller than a Prudhoe Bay Pad.



AECOM Slide Provided to ADEC Staff

What Technical Issues Still Need to be Addressed?

- Industry is double-checking revised stack assumptions
  - Will provide modeling files once revisions confirmed/updated
- Staff wants to check revised modeling files
  - Do revised assumptions adequately reflect future rigs / engines?
  - Develop recommended “restrictions”
- At some point, will need to work with industry regarding the meteorological, background and terrain data needs/assumptions for rest of Alaska

Policy-Level Issues

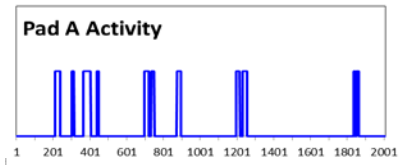
- Monte Carlo: OAQPS allows for minor permits, but not for PSD
  - Does ADEC want to open the door to separate modeling techniques?
  - Given split OAQPS response, will R10 allow for SIP analysis?
    - Should we check prior to SIP submittal or just provide our argument as part of SIP submittal?
- Project Focus: Existing Developments vs. Future Developments?
  - Answer affects whether we accept increased pad size in revised modeling

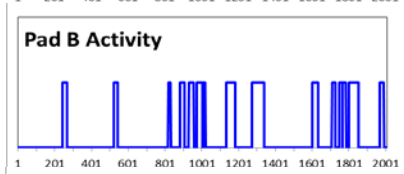
Other Items to Note

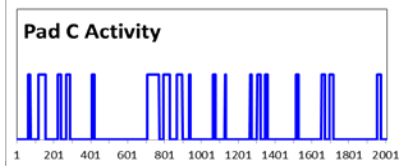
- Will likely need “clean” modeling analysis prior to SIP submittal
  - Industry used superseded version of AERMOD/AERMET
  - Other revisions prior to SIP submittal?
- Will also need confirmation that resulting approach (fuel limits) still protect the other air quality standards
- Still need to work through funding issue

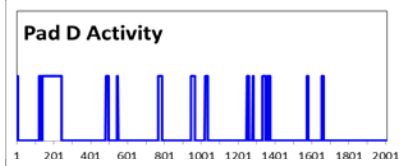
Back up slides below

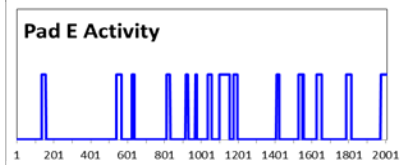
Actual Drill Rig Activity on North Slope Pads

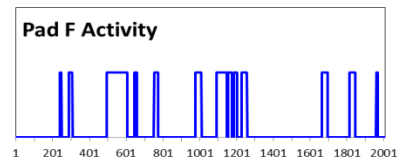


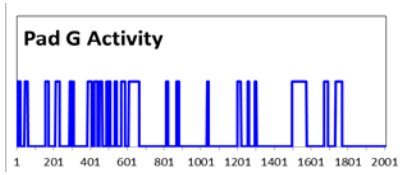


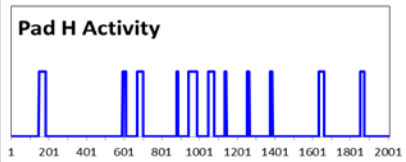


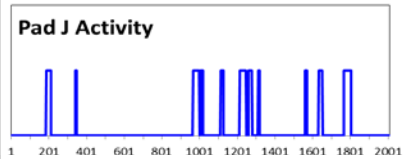


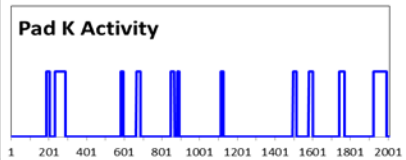


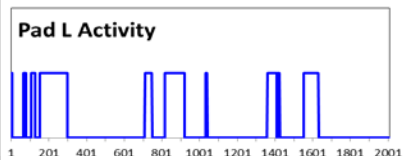


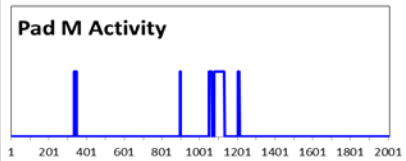


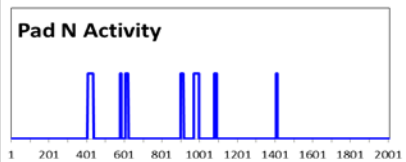


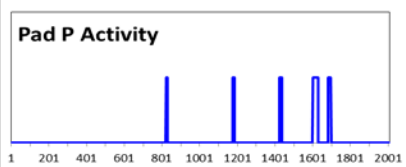


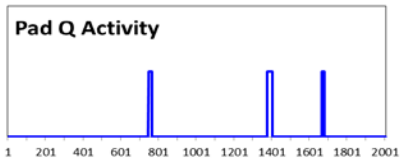


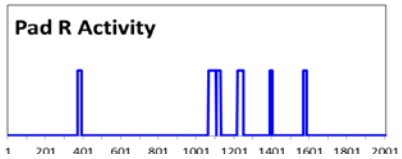


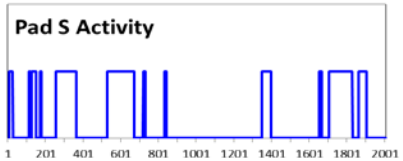


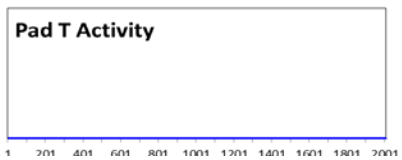


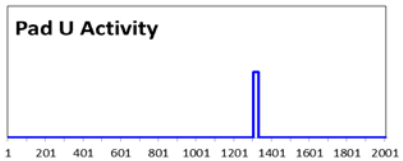


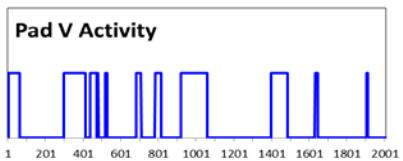




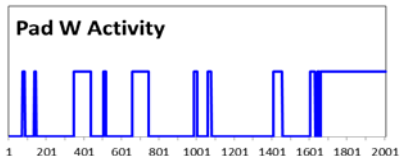


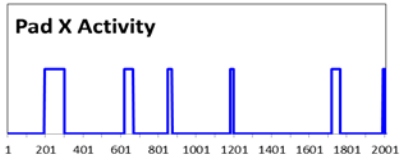


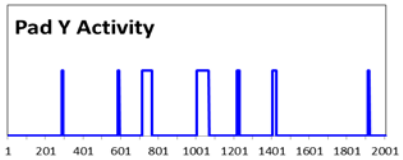


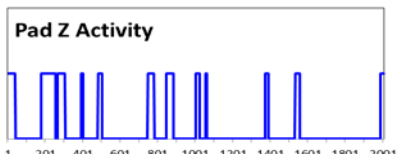


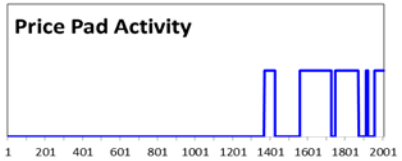
Drill Rig Activity (Days)

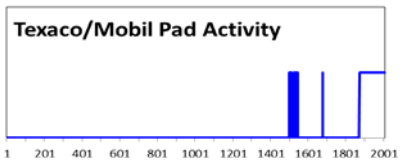












Drill Rig Activity (Days)

Simulated Drill Rig Activity for Top 10 Modeled Impacts