MPLX ENERGY LOGISTICS®

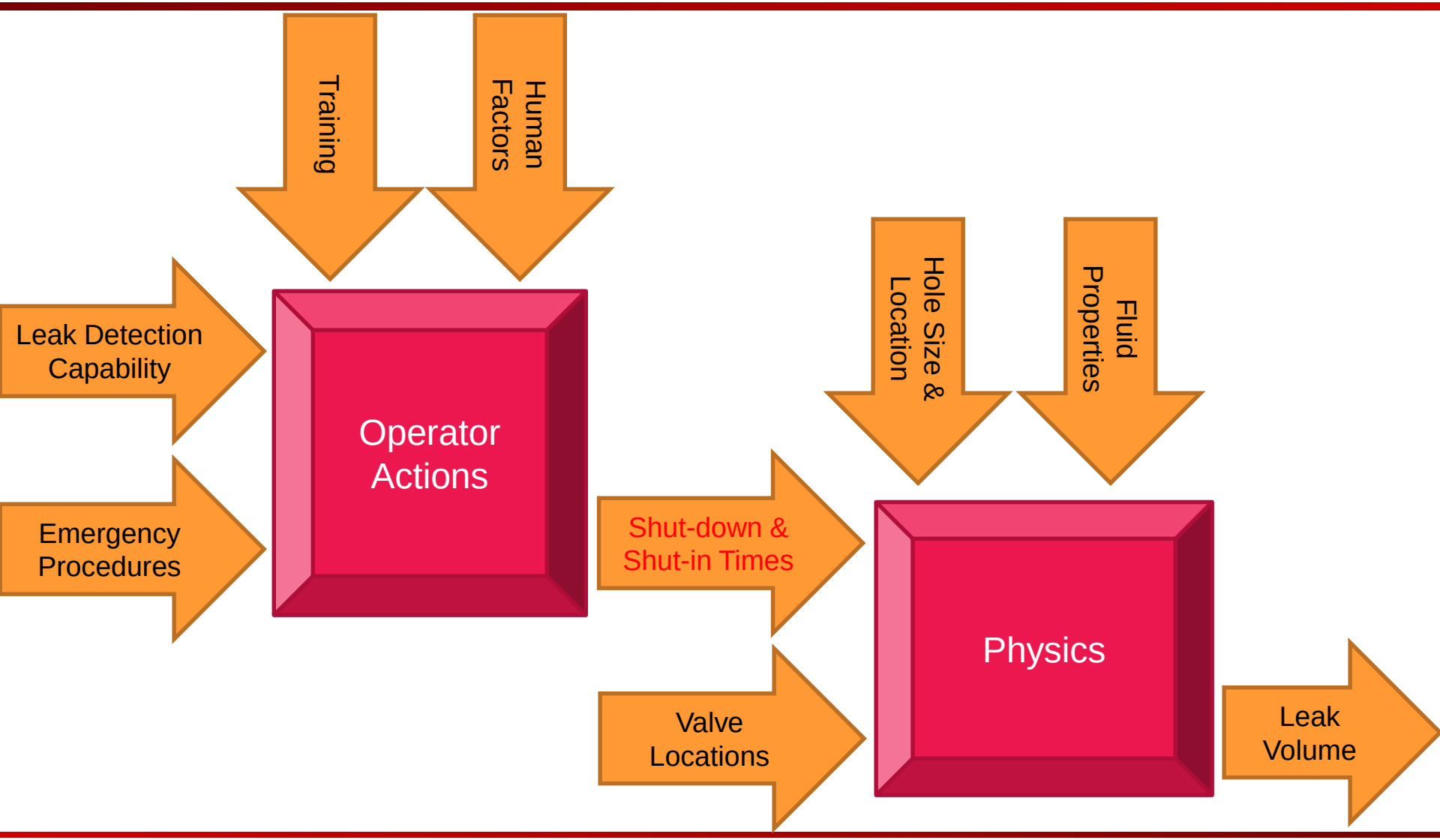
Emergency planning & response performance modeling

(human action impact on consequences)

Topics

- Estimating Operator Response Time
- Estimating Emergency Response Time

Factors affecting release volume



Typical Conversation to Solicit Estimates

Risk Analyst: "How long does it take to shutdown this pipeline?"

Operator: "I can't say. **It depends**."

Risk Analyst: "Depends on what?"

Operator: "Depends on where the release happens, whether we catch it before CPM does, if we are distracted by another critical task,….There are just **too many variables**."

Risk Analyst: "Can you give me your best estimate?"

Operator: "5 minutes? Wait, what is this being used for?"

Risk Analyst: "It will be an input into our risk model."

Operator: "In that case, 10 minutes."

Risk Analyst: "That seems like a very conservative estimate."

Operator: "No. There are some situations where it could take that long."

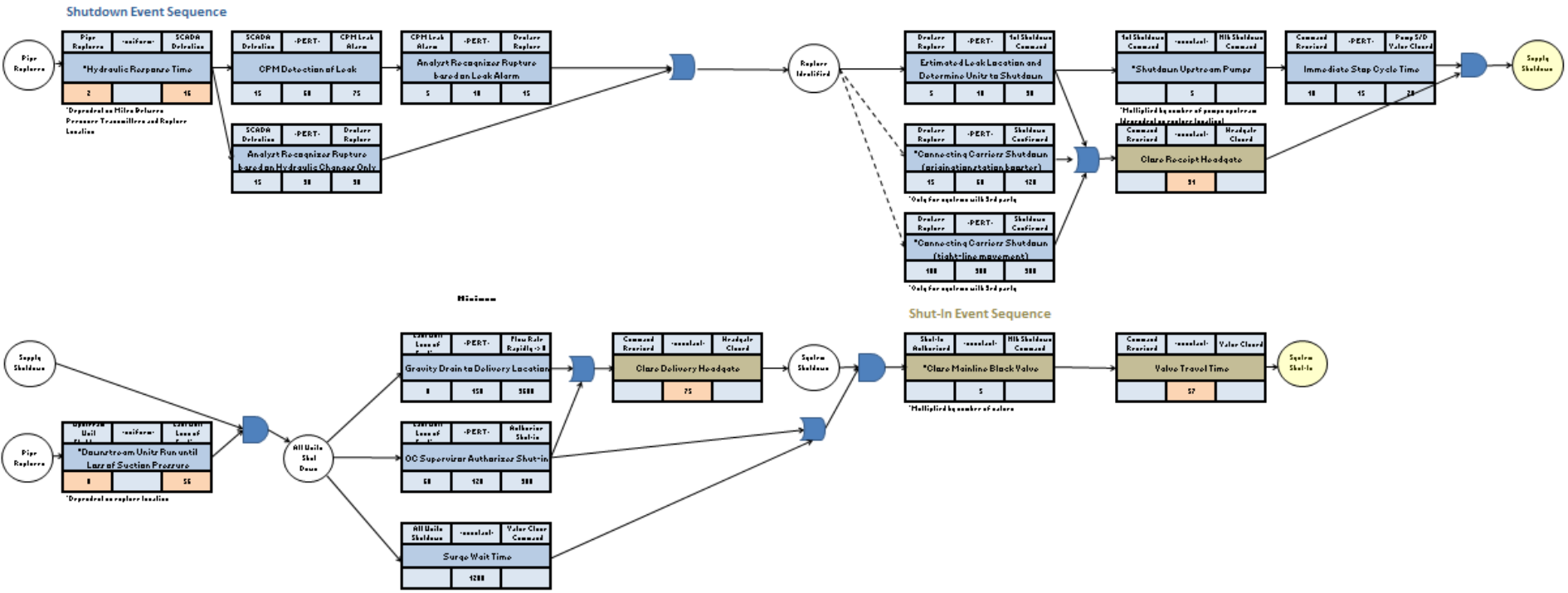
What is Monte Carlo Analysis?

Monte Carlo methods (or Monte Carlo experiments) are a broad class of computational algorithms that rely on **repeated random sampling** to obtain numerical results. They are often used in physical and mathematical problems and **are most useful when it is difficult or impossible to use other mathematical methods**. Monte Carlo methods are mainly used in three distinct problem classes: optimization, numerical integration, and **generating draws from a probability distribution**.

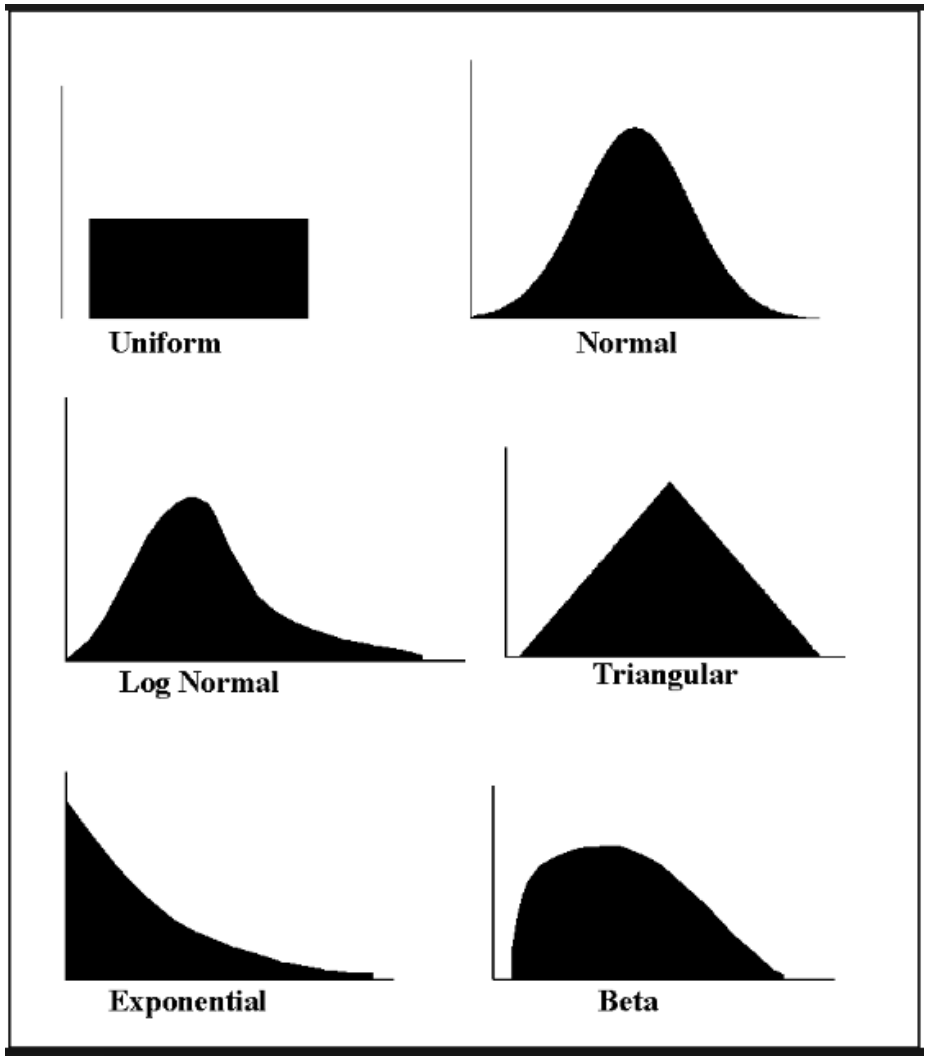
General Process:

1. Define a domain of possible inputs.
2. Generate inputs randomly from probability distributions over the domain.
3. Perform a deterministic computation on the inputs.
4. Aggregate the results.

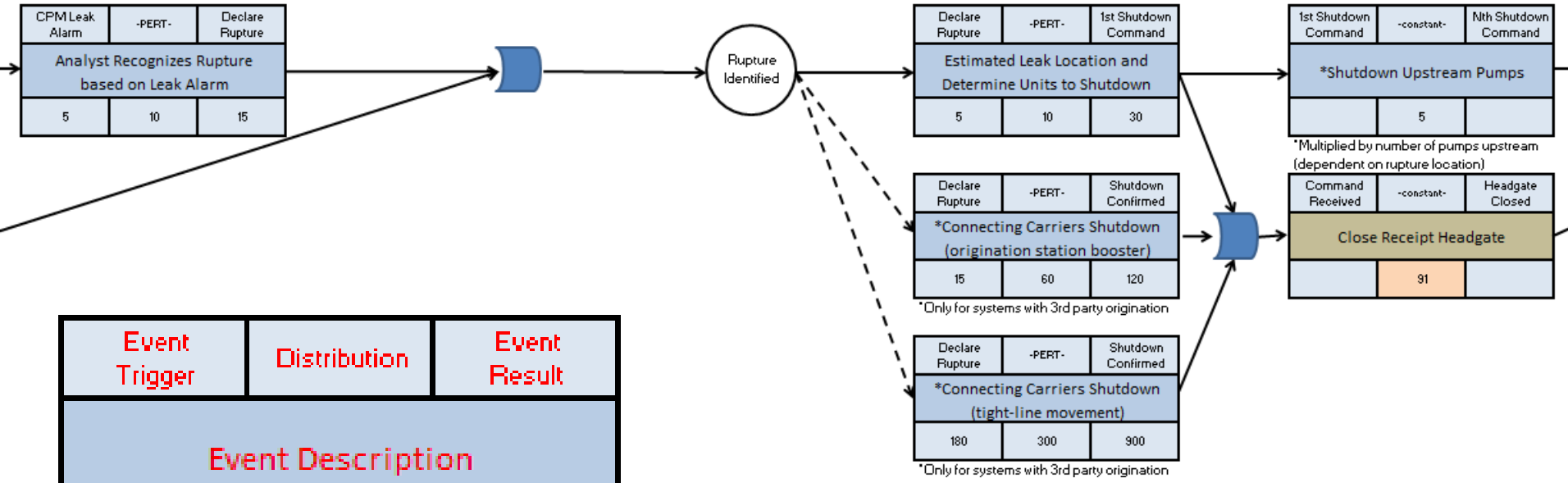
Sociotechnical Event Sequence



Probability Distribution Functions



Estimate PDF Parameters



Random Variables

Release location

CPM Time to Detect Leak

Analyst Recognizes Rupture based on Leak Alarm

Analyst Recognizes Rupture based on Hydraulic Change Only

Estimated Leak Location and Determine Units to Shutdown

Connecting Carriers Shutdown (origination station booster)

Connecting Carriers Shutdown (tight-line movement)

Gravity Drain to Delivery Location

OC Supervisor Authorizes Shut-in

Random Variables

Uniform

Release location

Beta (PERT)

CPM Detection of Leak

Analyst Recognizes Rupture based on Leak Alarm

Analyst Recognizes Rupture based on Hydraulic Change Only

Estimated Leak Location and Determine Units to Shutdown

Connecting Carriers Shutdown (origination station booster)

Connecting Carriers Shutdown (tight-line movement)

Gravity Drain to Delivery Location

OC Supervisor Authorizes Shut-in

Non-Random Variables

Constants

Product Type

Segment Length

Nominal Diameter

# of Mainline Booster Stations

# of Mainline Isolation Valve

Receipt Headgate Valve Travel Time

Delivery Headgate Valve Travel Time

RMOV Valve Travel Time

Third Party Origination Booster

Third Party Tight Line Movement

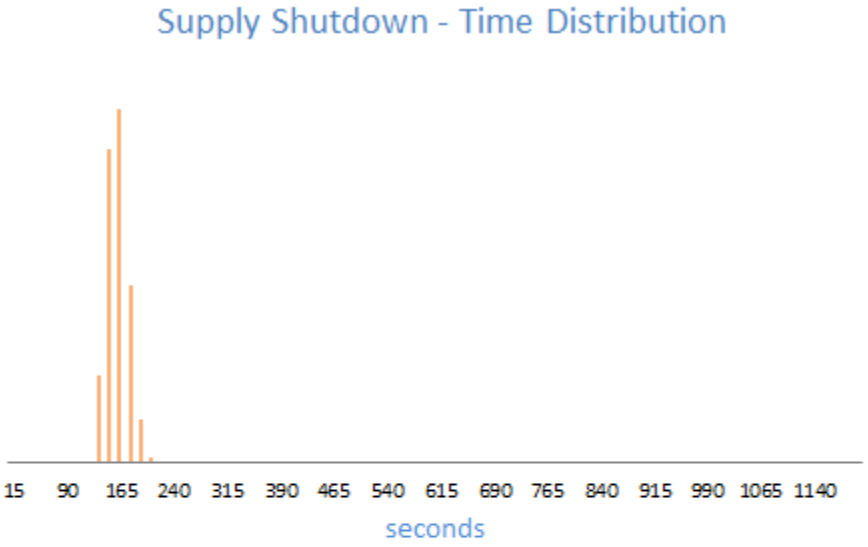
Calculated Variables

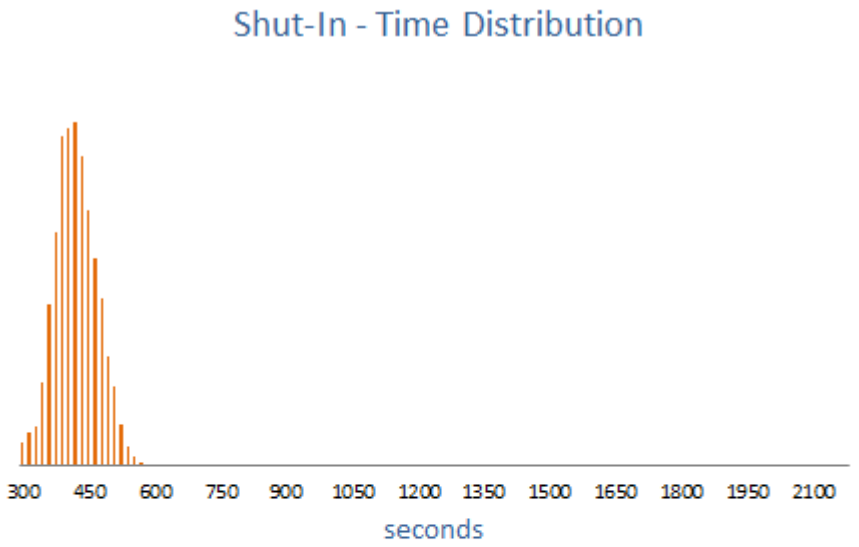
Speed of Sound in Product

Hydraulic Response Time

Downstream Units Run until Loss of Suction Pressure

Results

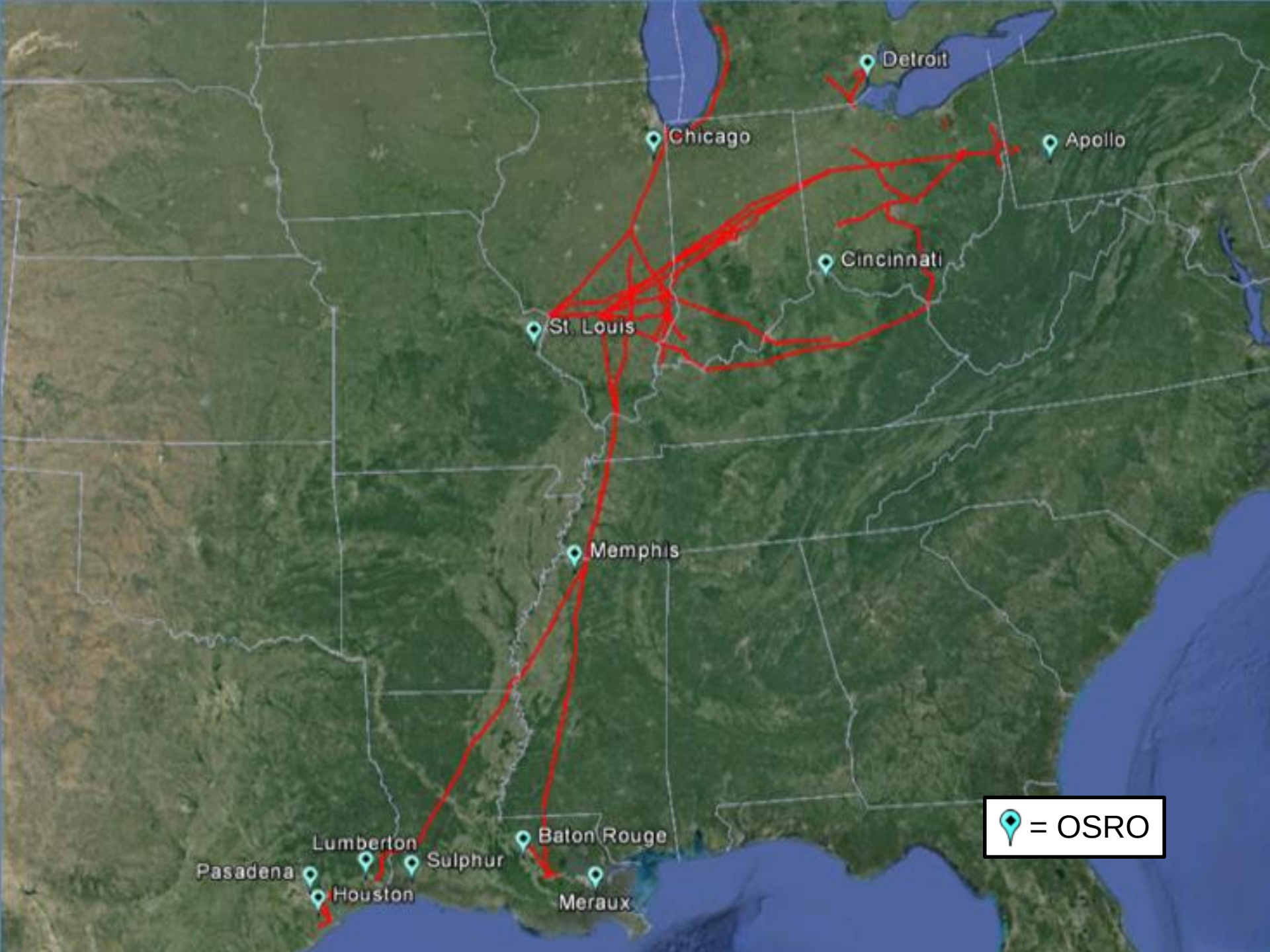




Shutdown		
Response	Time	
P5	131	(2m 11s)
P50	**153**	**(2m 33s)**
P60	157	(2m 37s)
P70	162	(2m 42s)
P80	167	(2m 47s)
P90	174	(2m 54s)
P95	180	(2m 60s)
P100	209	(3m 29s)

Detected By	Percent
CPM Alarm	6%
Hydraulic Analysis	94%

Shut-In		
Response	Time	
P5	337	(5m 37s)
P50	**411**	**(6m 51s)**
P60	424	(7m 4s)
P70	438	(7m 18s)
P80	455	(7m 35s)
P90	478	(7m 58s)
P95	497	(8m 17s)
P100	581	(9m 41s)


Detroit
Chicago
Apollo
Cincinnati
St. Louis
Memphis
Baton Rouge
Lumberton
Sulphur
Pasadena
Houston
Meraux
= OSRO

Random Variables

Release location

Spill volume

Day of the year

Day of the week

Time of day

OSRO preparation time

OSRO travel time

OSRO staging time

OSRO deployment time

River speed

Random Variables

Uniform

Release location

Spill volume

Day of the year

Day of the week

Time of day

Beta (PERT)

OSRO preparation time

OSRO travel time

OSRO staging time

OSRO deployment time

River speed

Google Travel Times

Leak Points

7

OSROs

6

Run

Calculate

Clear

Directions

1. Enter one or more lat, long
2. Click "Run"
3. If errors occur during calculation, click "Run" again.
4. Repeat process until all times are populated.
5. Click "Calculate" to view results.

	Lat	Long	Spill Volume	OSRO	1	2	3	4	5	6
1	40.76142855	-83.29879905	457.99	MMP	53	112	107	129	118	116
2	40.8060379	-83.36718535	770.04	MMP	44	104	112	123	122	120
3	40.81514221	-83.37796581	784.91	MMP	44	104	115	120	121	119
4	40.90531849	-83.51262494	560.49	MMP	40	101	109	125	131	129
5	40.95103078	-83.58401269	843.7	MMP	38	99	103	128	134	131
6	40.99761868	-83.64869817	1,084.41	WCD	97	138	246	255	415	569
7	41.02929129	-83.67032157	1,089.01	WCD	93	137	251	251	414	568

Leak Location

Google Travel Times

Leak Points

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Spill Volume

Google Travel Times

Leak Points

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OSRO Type

Google Travel Times

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Google Travel Time

Google Travel Times

Leak Points

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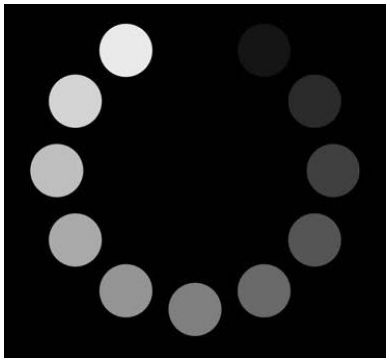
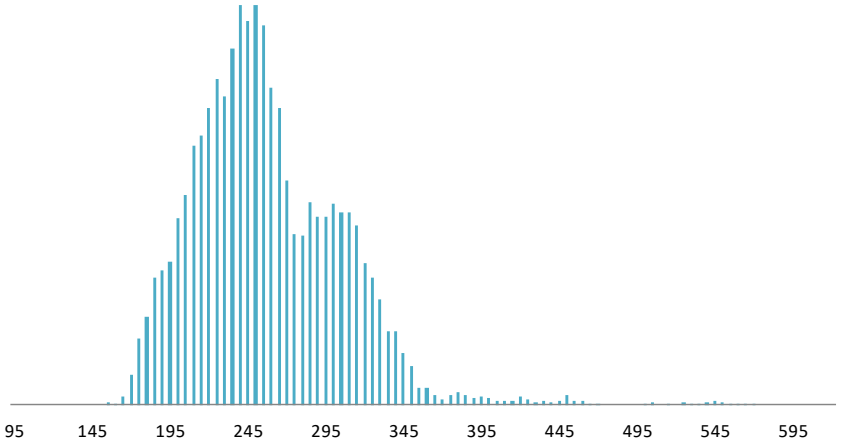
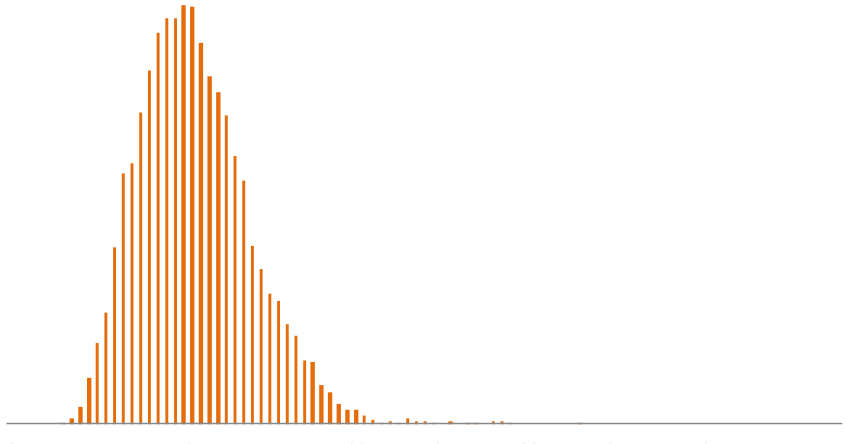


Response Time Distribution



Downstream Migration Distance Distribution



	Minutes	HH:MM
Min	156	2:36
P50	253	4:13
P75	290	4:50
P95	337	5:37
Max	573	9:33

Return to Inputs

	Miles
Min	5.3
P50	12.6
P75	14.9
P95	18.7
Max	35.4