NASA Quantitative Risk Assessment Applied to the Oil & Gas Industry

AIAA ANNUAL TECHNICAL SYMPOSIUM

May 6, 2016

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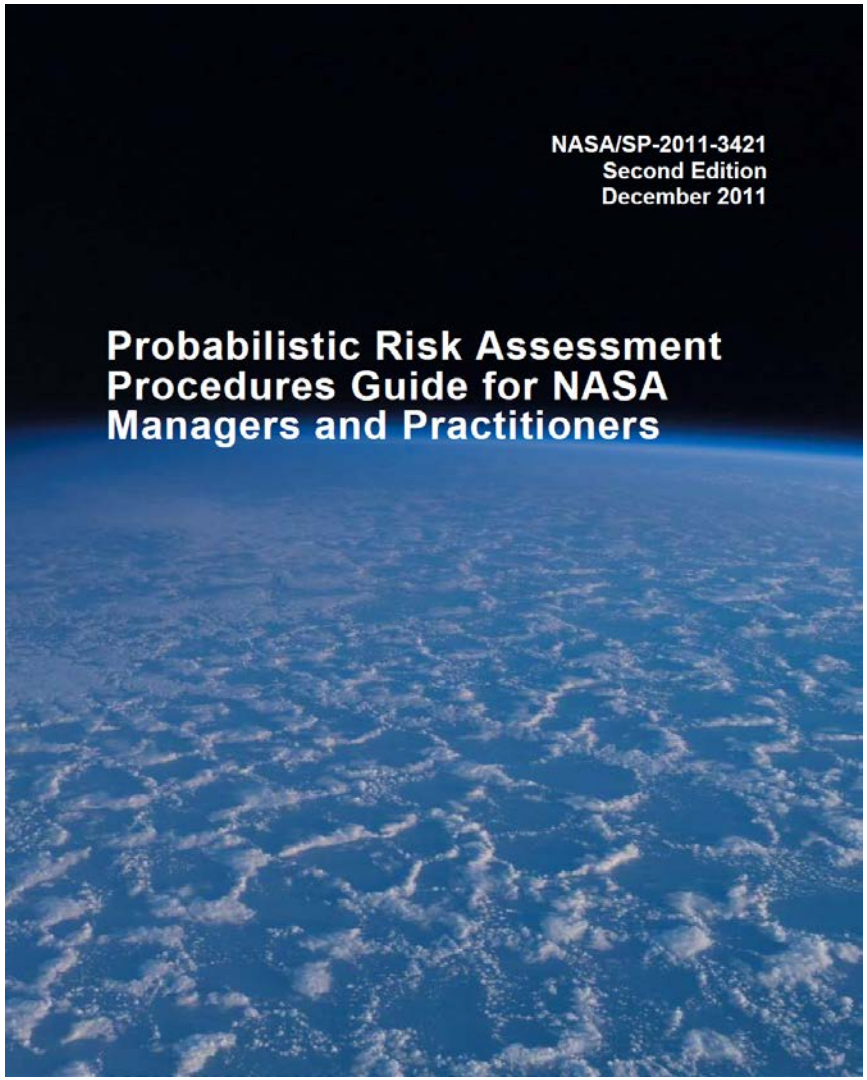
Agenda

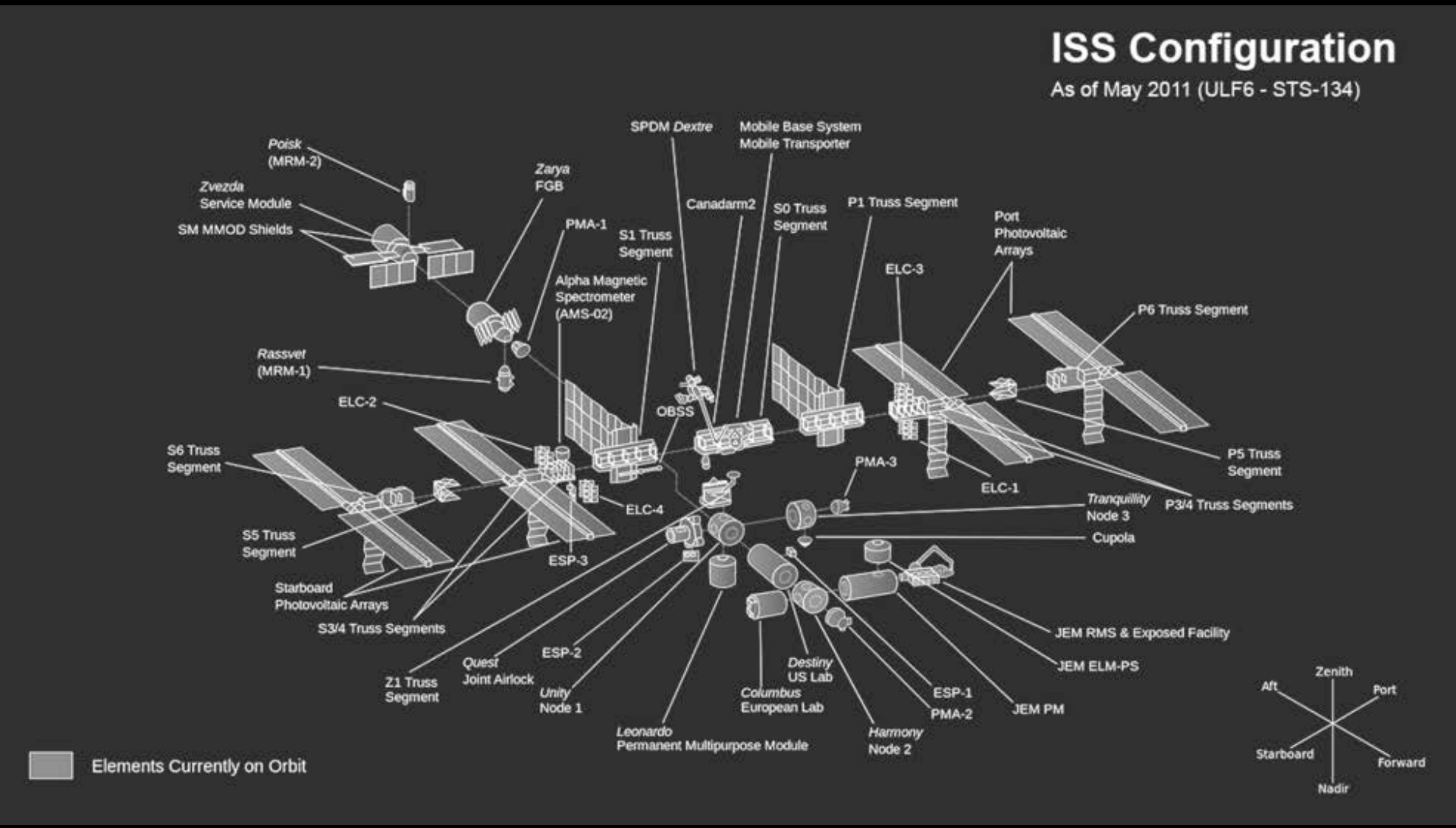
- Brief Introduction to Probabilistic Risk Assessment (PRA)
- History of PRA
- Bureau of Safety and Environmental Enforcement (BSEE)
- NASA – BSEE Interagency Agreement



"Probabilistic Risk Assessment (PRA) is a comprehensive, structured, and logical analysis method aimed at identifying and assessing risks in complex technological systems for the purpose of cost-effectively improving their safety and performance."

--Introduction; page 1-1

International Space Station



Probabilistic Risk Assessment

PRA's systematically connect design, logic, operations, human interaction and external influences for all aspects of large complex machines/processes to detect dependencies and effects that the human mind just could not track and grasp on its own

- PRA's take into account external events
- PRA's take into account **Human Error** and **Common Cause**
- PRA's link functional dependency of systems and operations
- PRA's perform uncertainty analysis
- PRA's do all of this in an Integrated model

Probabilistic Risk Assessment

PRA's are used to model and quantify rare events

- If we had 100,000 space stations operating for 40 years each with a catastrophic failure of 500 of them we could do standard statistics to estimate the probability of catastrophic failure of a space station

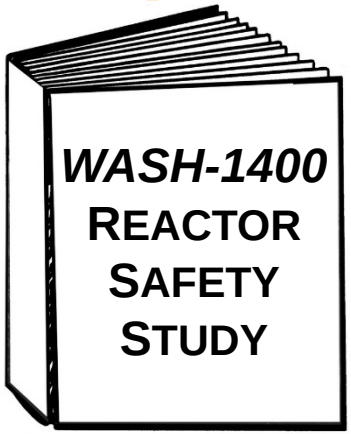
- However we have only one space station and it has had minimal experience and no catastrophic failures. Therefore there will rarely be any statistically significant data since it is in rare event territory.

History of PRA: Nuclear Power Industry

Three Mile Island Accident
March 28, 1979

1970 1975 1980

1st PRA :



All new Nuclear Plants are licensed by the NRC based on PRA

History of PRA: NASA

Space Shuttle ***COLUMBIA***
February 3, 2003

PRA's for Human Space Flight
[led by team at JSC]

Space Shuttle

International Space Station

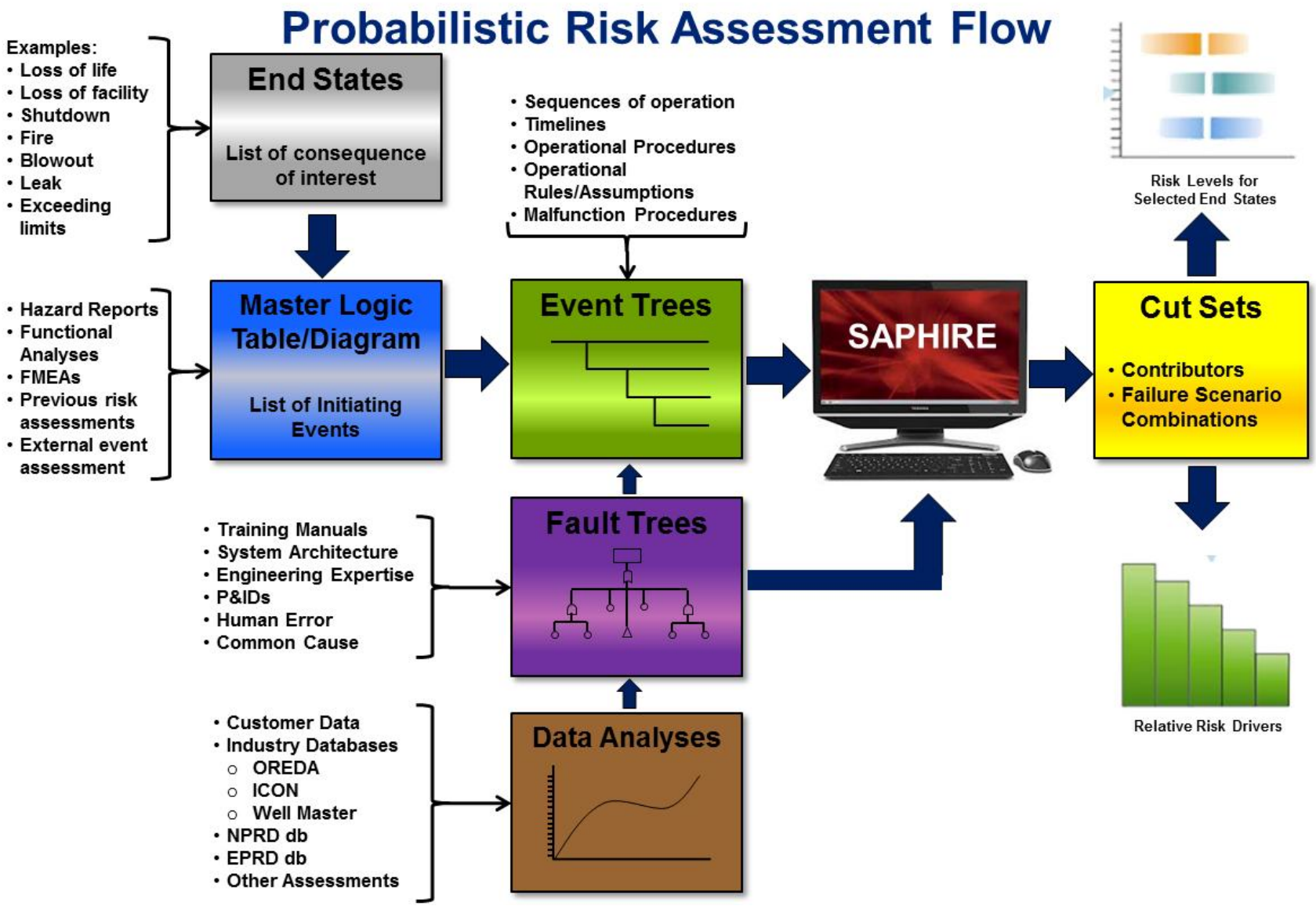
Constellation Program

Orion Capsule

Cross Program

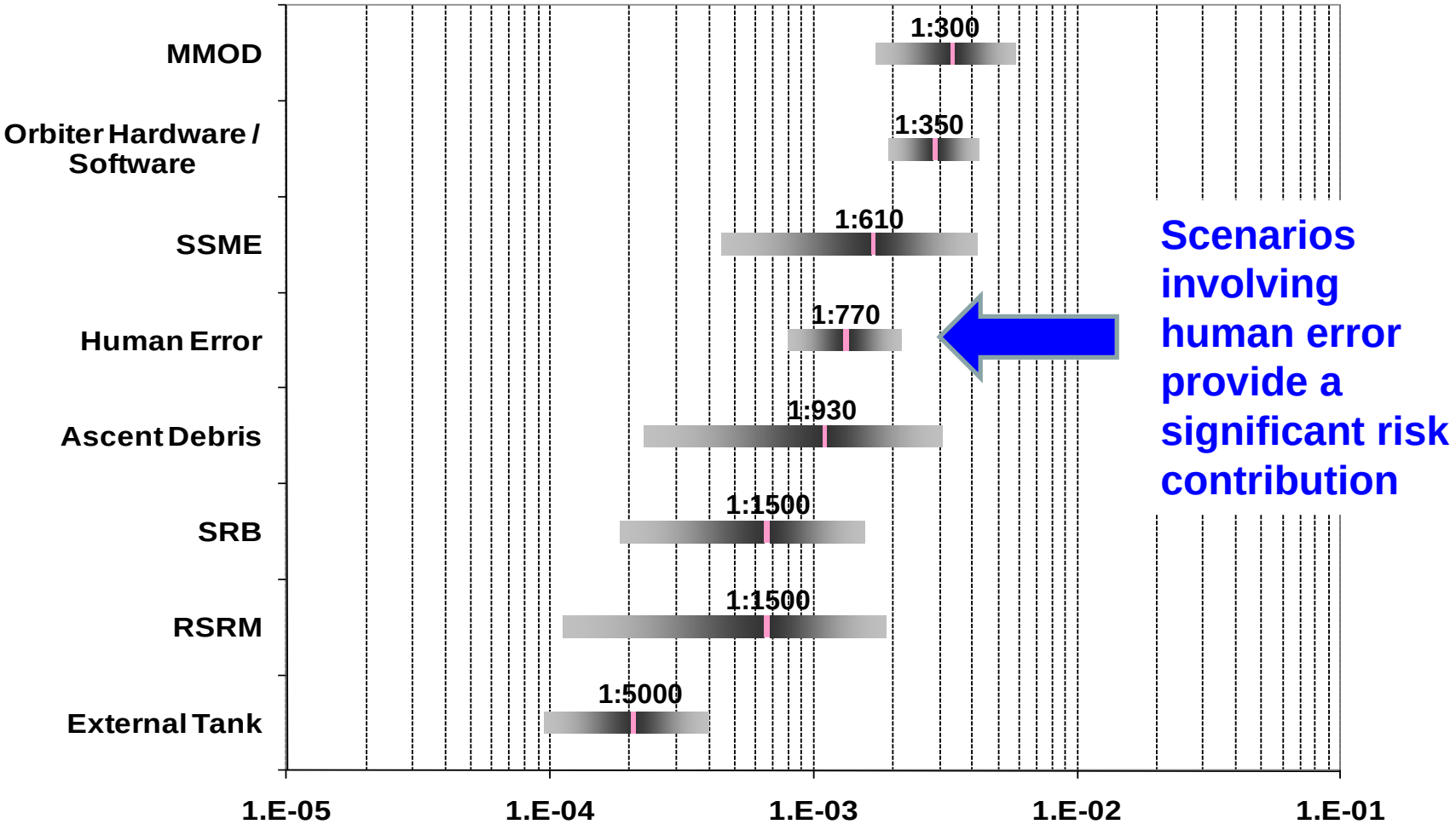
Commercial Crew

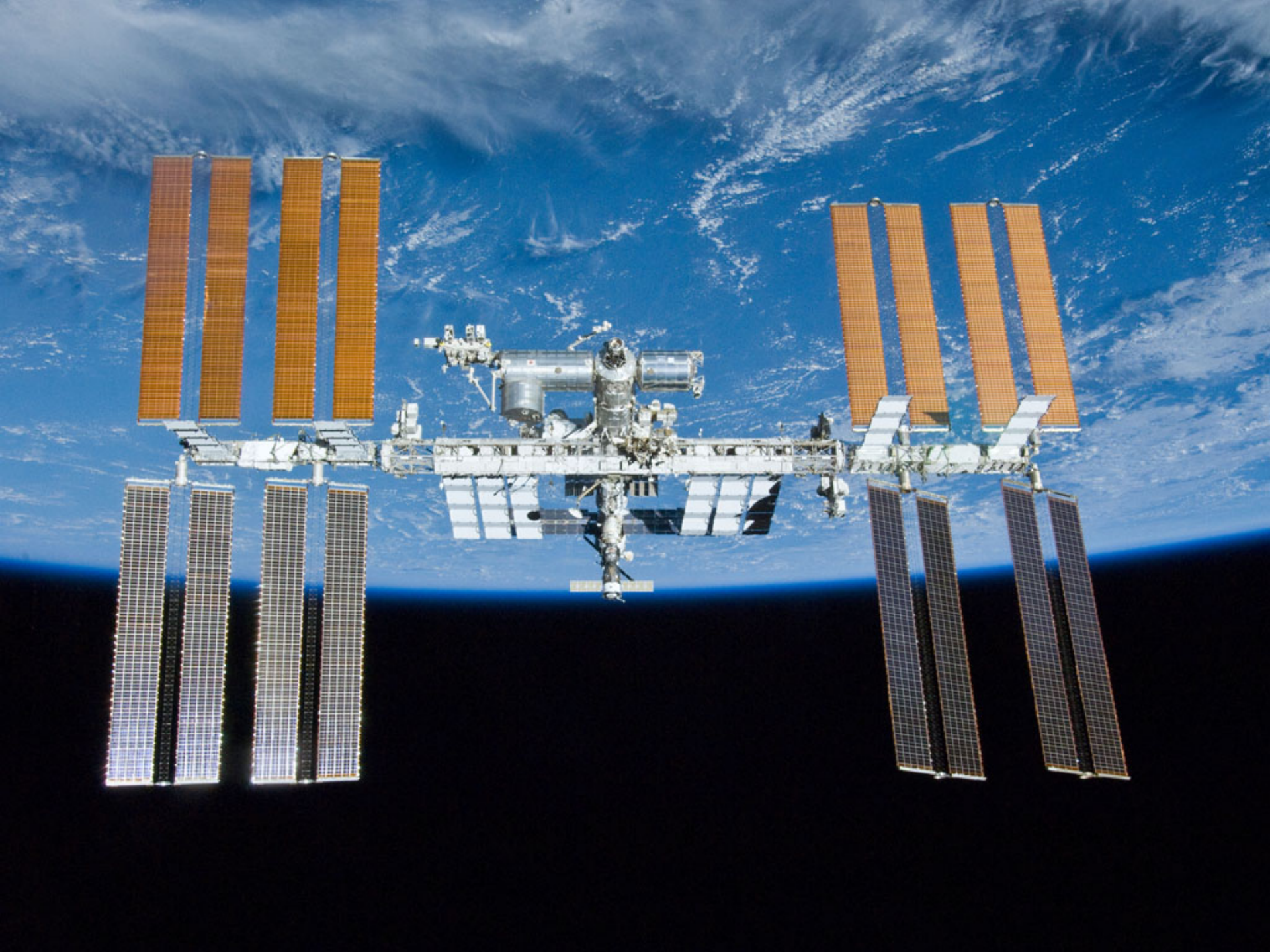
Probabilistic Risk Assessment (PRA)



Space Shuttle Program PRA

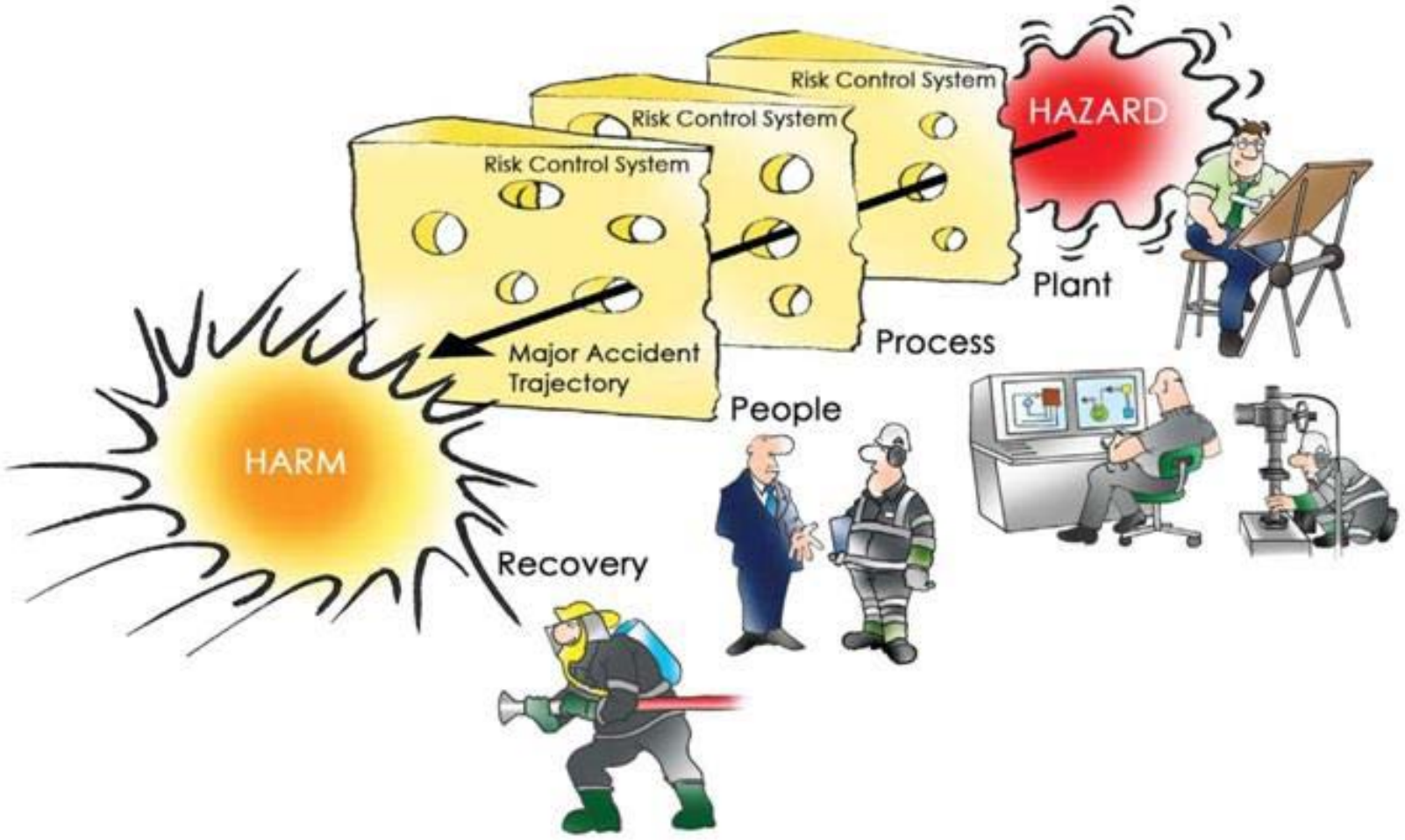
SHUTTLE PRA ITERATION 3.2 CONTRIBUTIONS BY ELEMENT OR MAJOR AREA





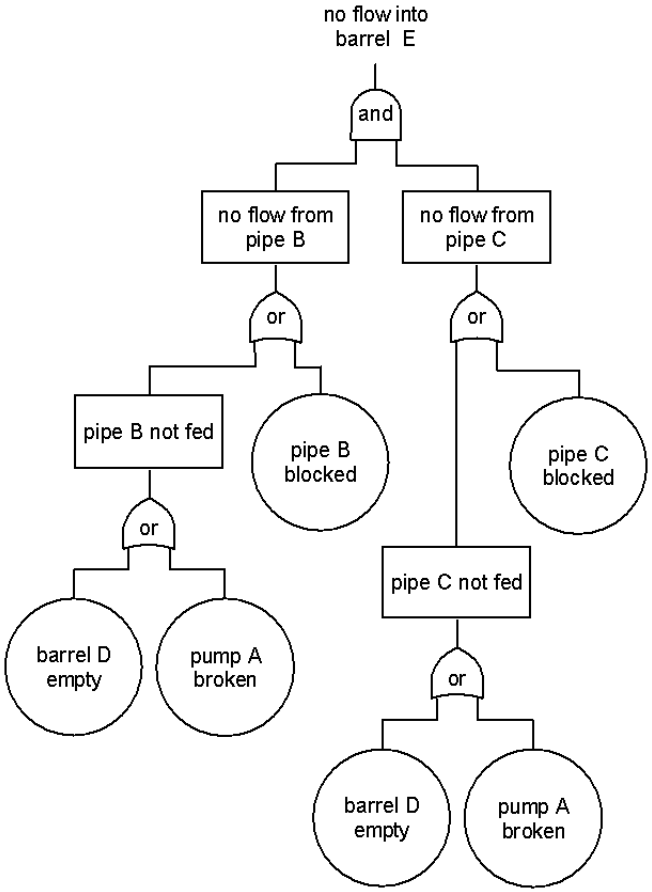
Shell *PERDIDO* Deepwater Platform

Barrier Based Risk Management

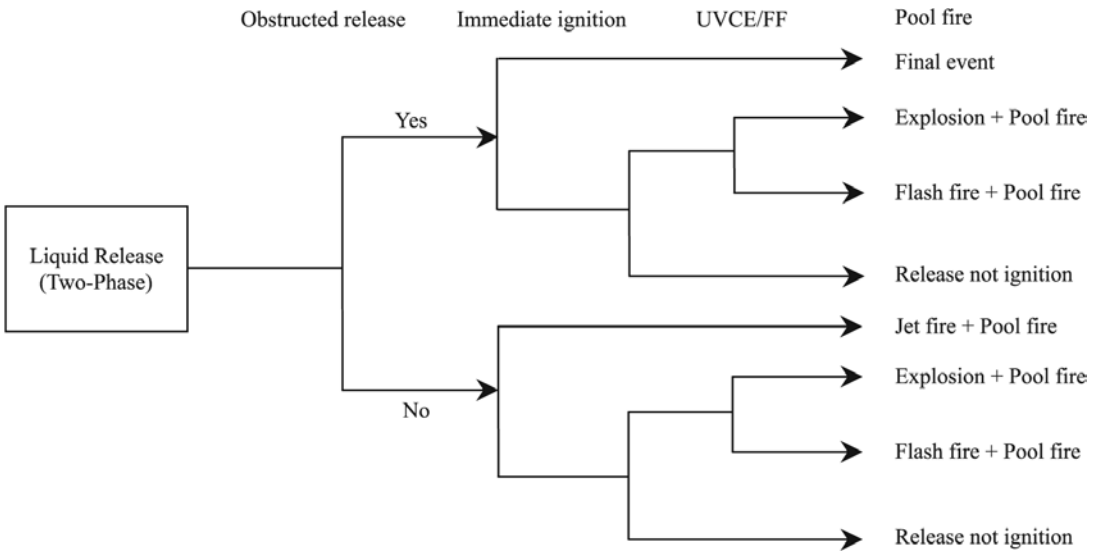


Qualitative Risk Assessment

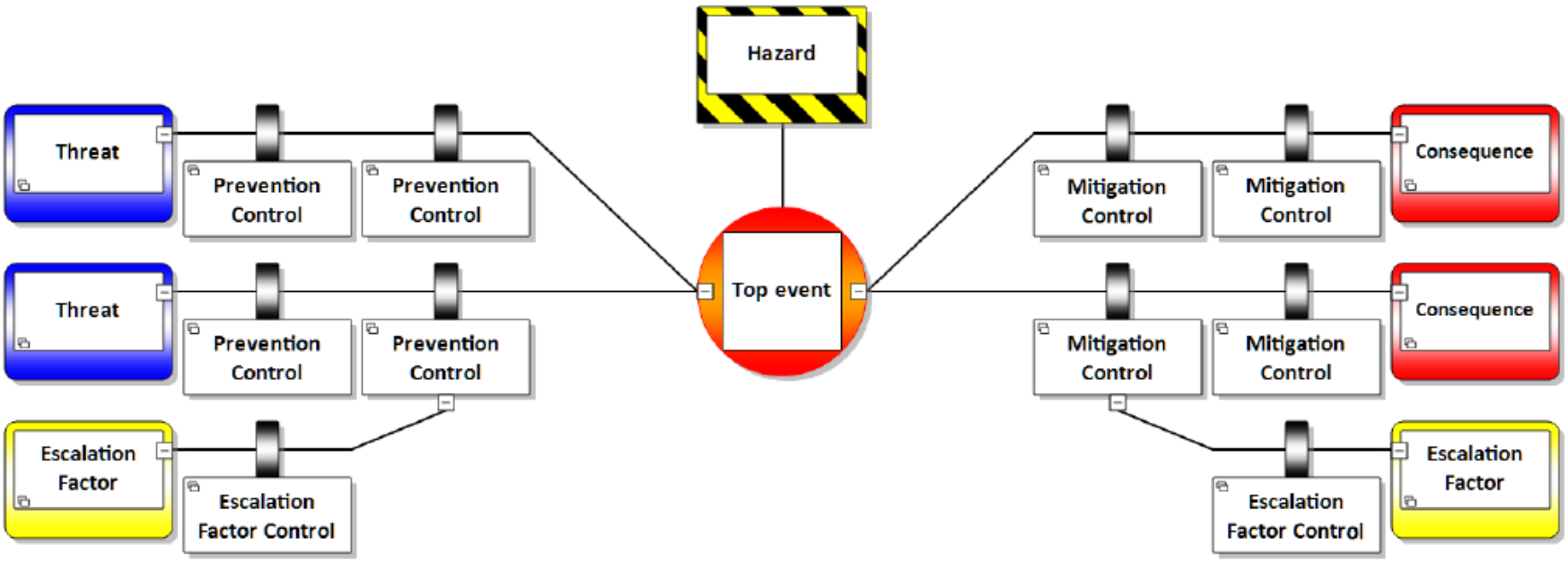
Fault tree



Event tree

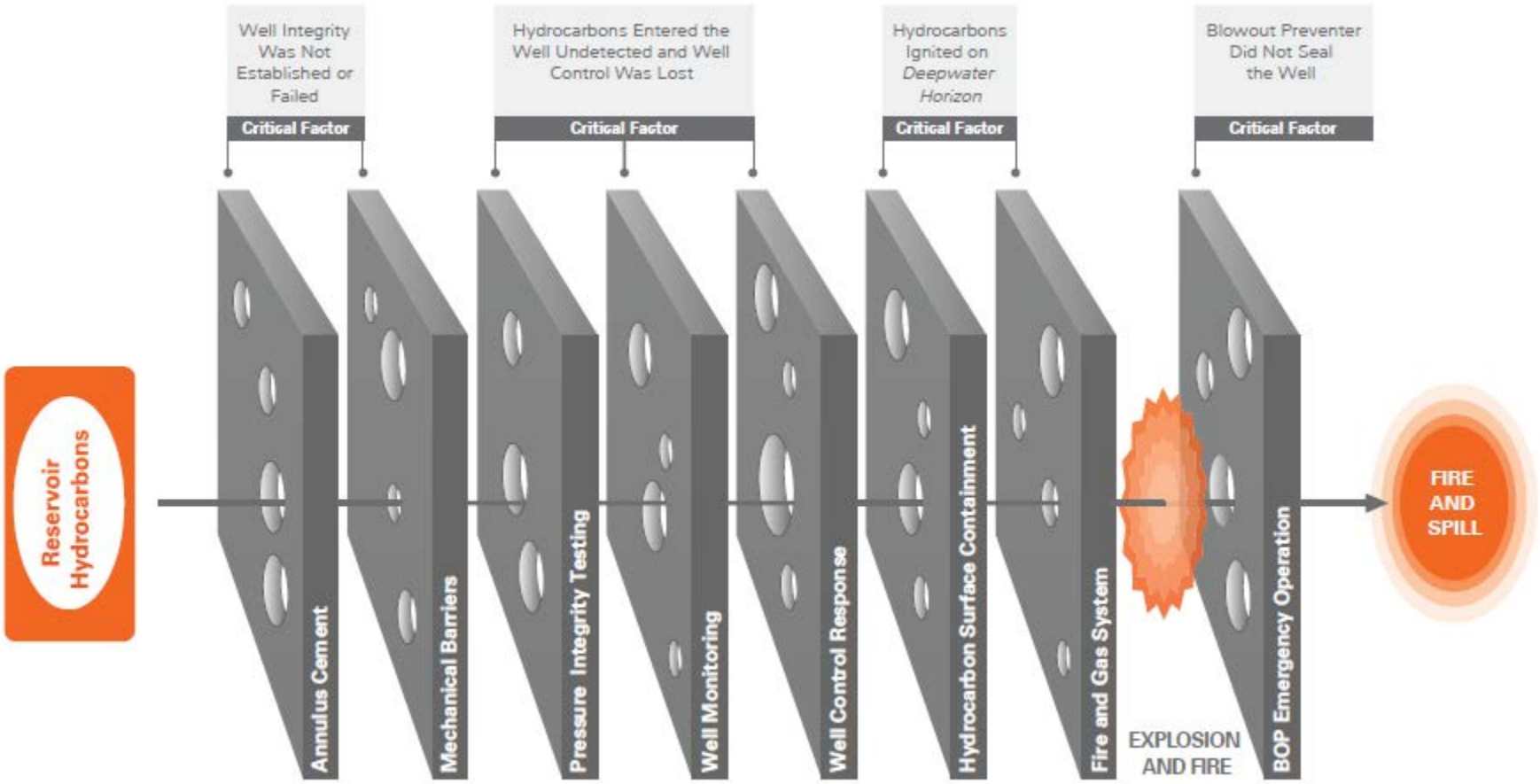


Basic BowTie



Deepwater Horizon - April 20, 2010

Qualitative Barrier Analyses



Deepwater Horizon 8 Key Findings

The Frontline Group™

U.S. Department of the Interior (DOI)

Formed: January 19, 1982

The **Minerals Management Service (MMS)** was an agency of the United States Department of the Interior that managed the nation's natural gas, oil and other mineral resources on the outer continental shelf (OCS).

Deepwater Horizon
April 20, 2010

Renamed: May 19, 2010

Dissolved: October 1, 2011

U.S. Department of the Interior (DOI)

October 1, 2011

BOEM
Bureau of Ocean Energy Management

BSEE
Bureau of Safety and Environmental Enforcement

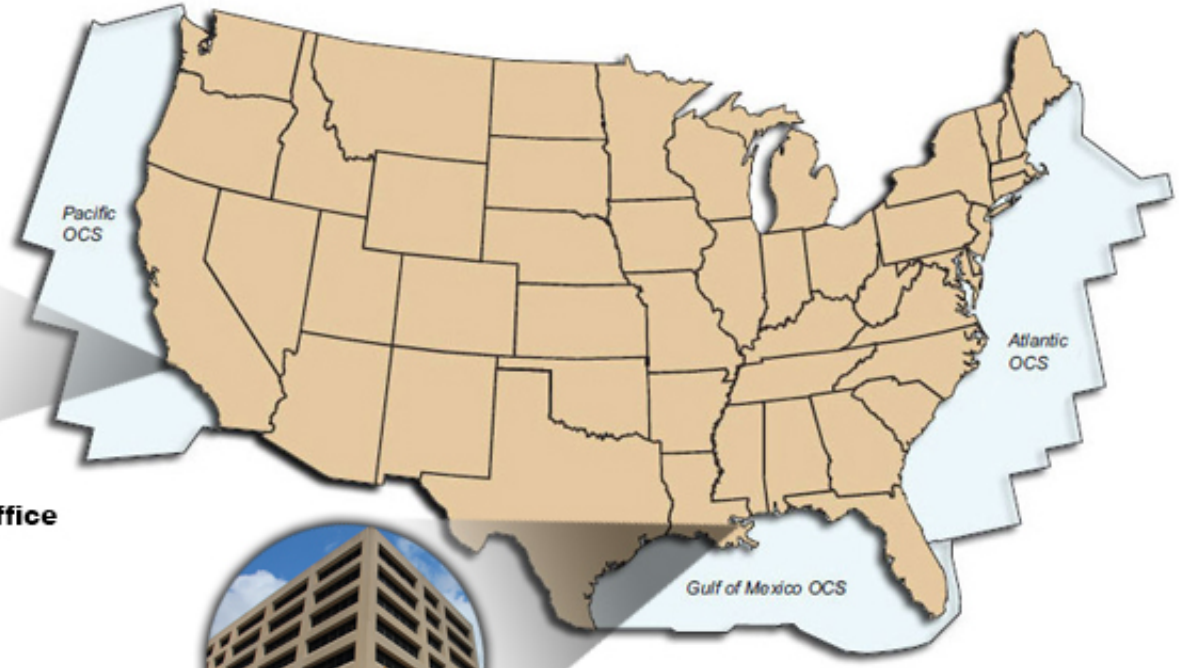
ONRR
Office of Natural Resources Revenue

Bureau of Safety and Environmental Enforcement

Mission Statement: The Bureau of Safety and Environmental Enforcement (BSEE) works to promote safety, protect the environment, and conserve resources offshore through vigorous regulatory oversight and enforcement.

Bureau of Safety and Environmental Enforcement

BSEE Alaska Region Office
3801 Centerpoint Dr Ste 500
Anchorage, AK 99503



BSEE Pacific Region Office
760 Paseo Camarillo
Suite 102, 1st Floor
Camarillo, CA 93010

BSEE Gulf of Mexico Region Office
1201 Elmwood Park Blvd
New Orleans, LA 70123

NASA – BSEE Interagency Agreement

BSEE
Bureau of Safety and Environmental Enforcement

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BSEE, NASA Announce Agreement to Examine Risk Offshore

03/17/2016
WASHINGTON

The Bureau of Safety and Environmental Enforcement (BSEE) and The National Aeronautics and Space Administration (NASA) have announced a five-year agreement allowing BSEE to capitalize on the best risk management approaches from the aeronautics industry to inform stakeholders and further strengthen worker and environmental safety protections on the Outer Continental Shelf.

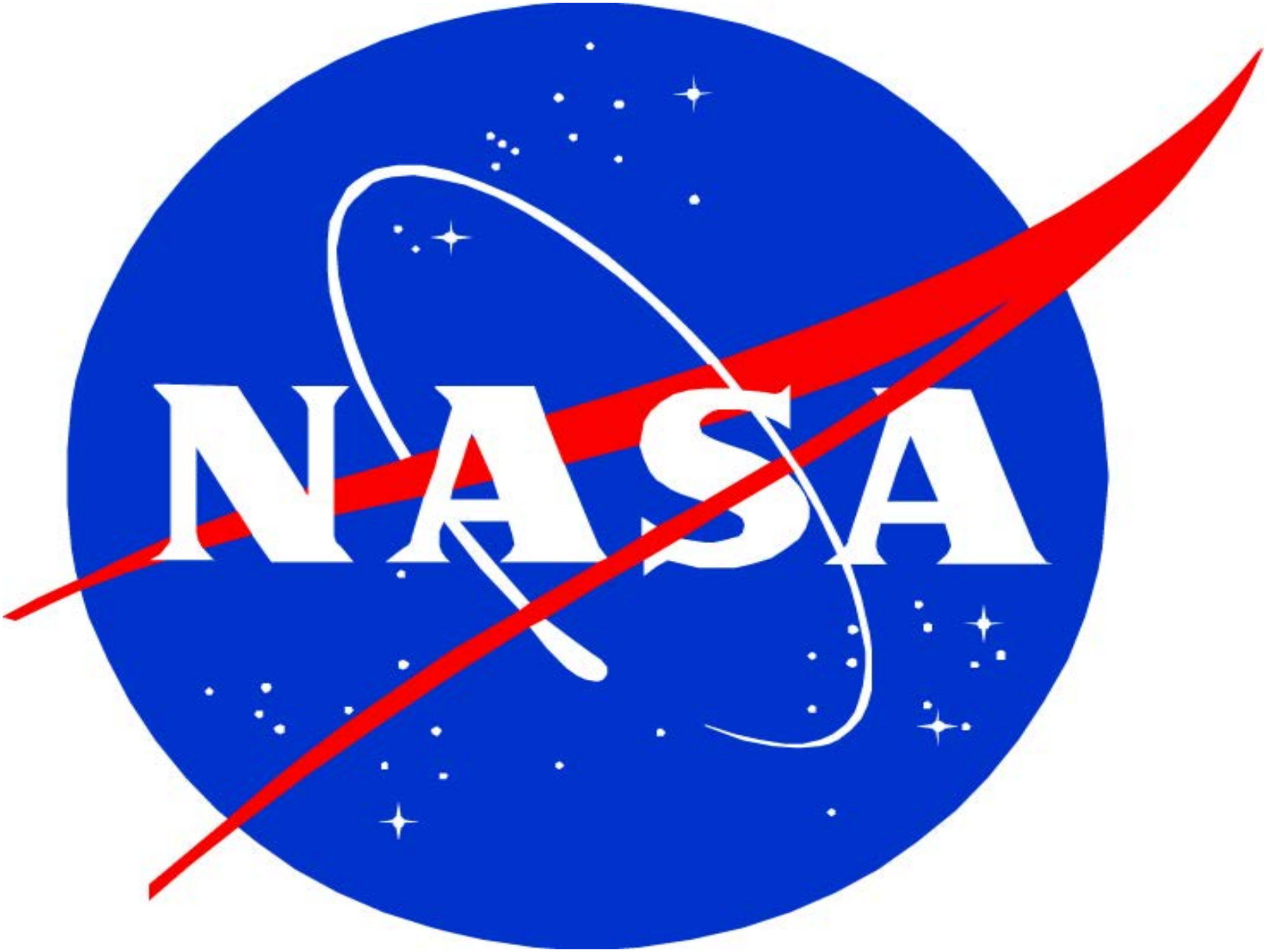
"Both BSEE and NASA work in harsh and uncompromising environments, relying on cutting edge technology to go deeper and further than previously thought possible," said BSEE Director Brian Salerno. "This partnership brings together technical experts from BSEE and NASA to focus on the specific risks associated with offshore operations so that we can continue to find ways to improve safety for offshore workers and protect the environment."

Under the agreement, NASA will assist BSEE in achieving three primary objectives:

- further develop BSEE's risk management capability through the use of NASA's probabilistic risk assessment technique;
- evaluate, design, and test technologies and hardware, including emerging technologies and best available and safest technologies; and
- assess failures and near miss occurrences using the resources and expertise of NASA's accredited failure analysis laboratory at the Johnson Space Center in Houston.

Used by NASA, probabilistic risk assessment is a technique to quantitatively model risk. It was used in the modeling of the Space Shuttle Program and is presently being used for the International Space Station and Orion deep space capsule programs.

"Whether the task takes one to deep space, or into the deep ocean, the analysis of the environment, training of personnel and risk mitigation factors are similar," said Jack James, technology transfer strategist at the Johnson Space Center. "NASA is pleased to work with BSEE, and we endeavor to learn best practices from each other."


NASA