Risk Management at NASA and Its Applicability to the Oil & Gas Industry

PRA INFORMATION DAY FOR INDUSTRY

March 1, 2018

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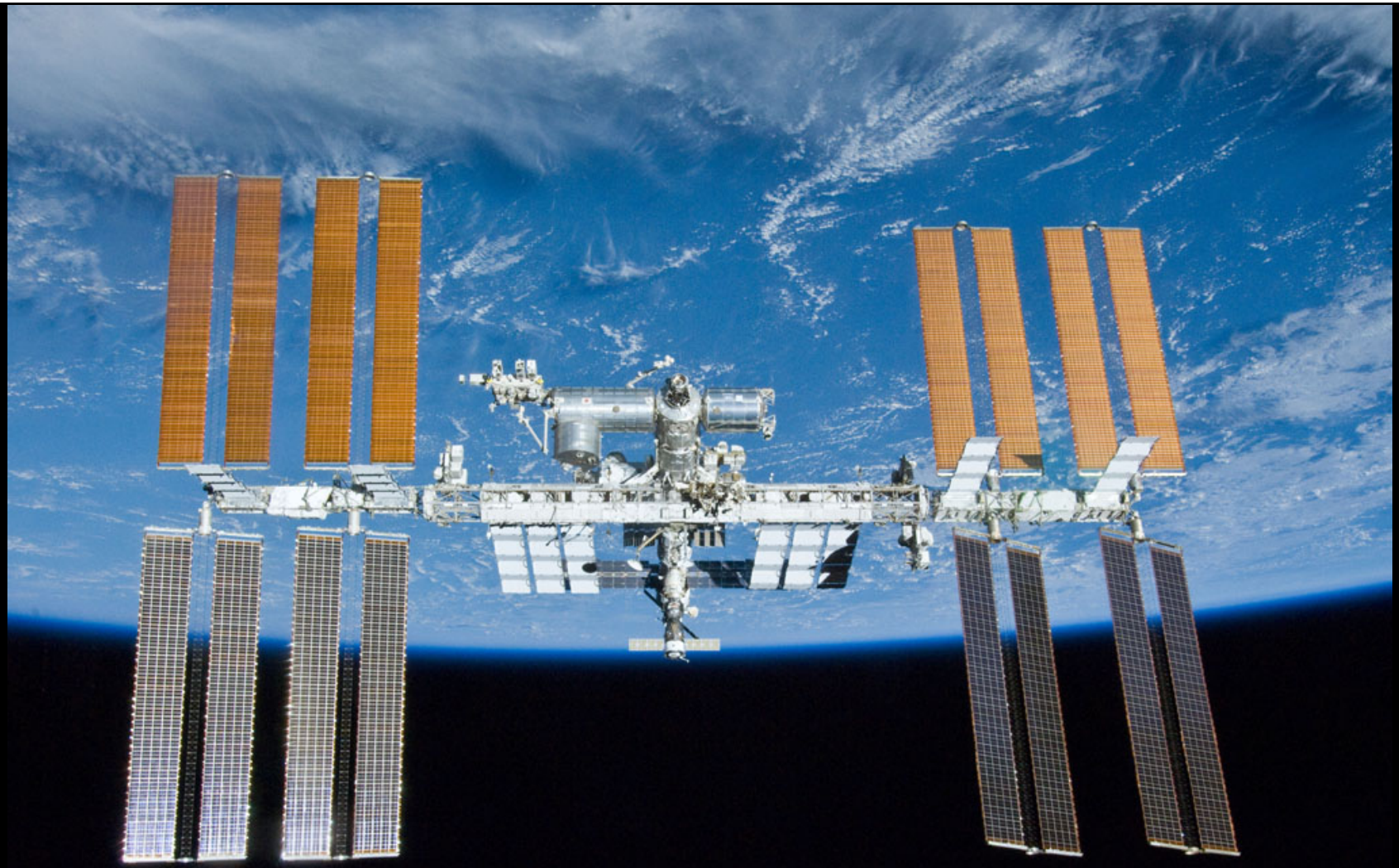
1. Why is NASA's experience relevant to offshore oil and gas?

2. What is Probabilistic Risk Assessment (PRA)?

3. What is the relationship between NASA and BSEE Headquarters?

4. What is NASA presently doing with Anadarko Petroleum Corporation and with Shell International Exploration and Production?

International Space Station



International Space Station

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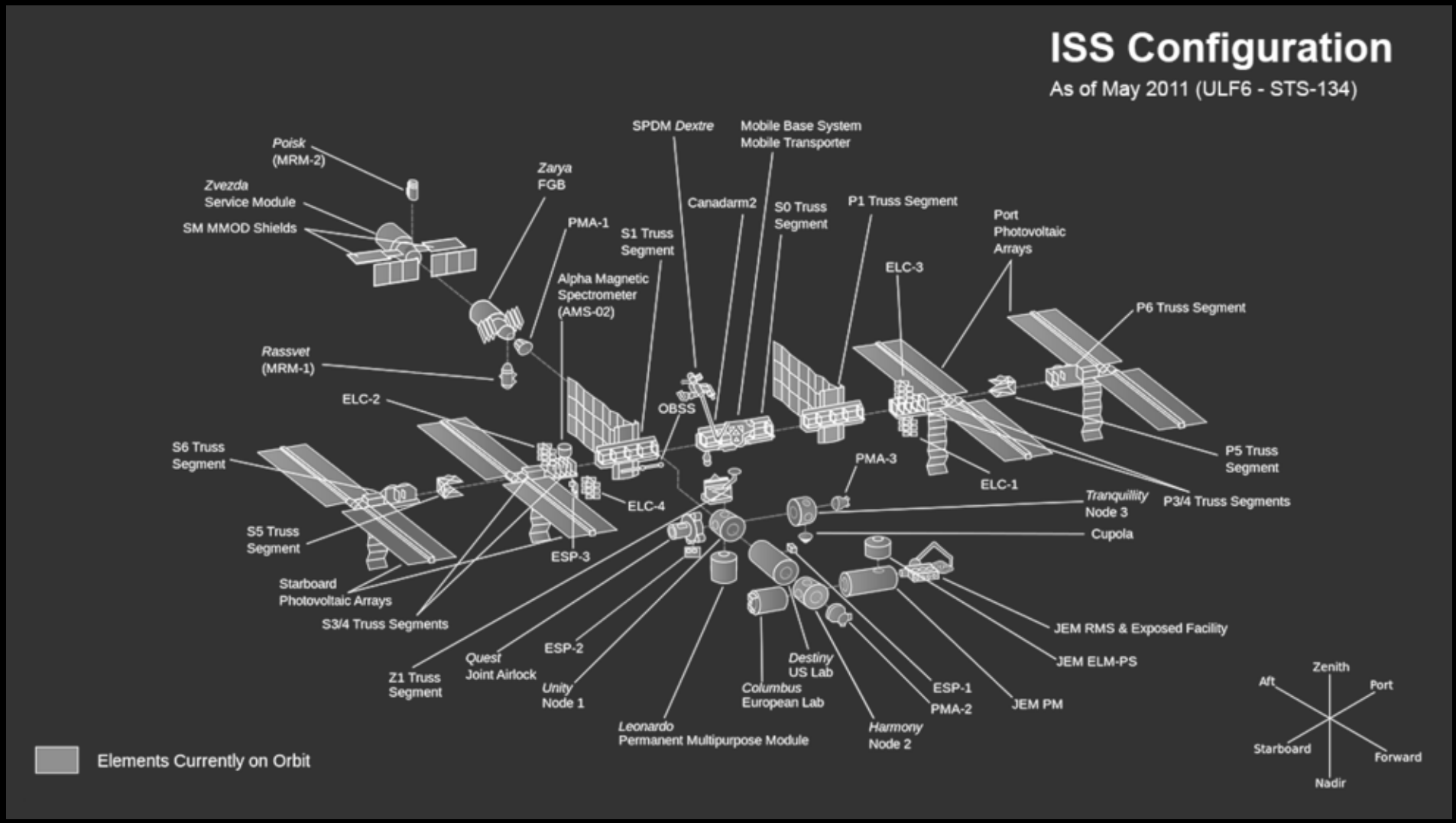
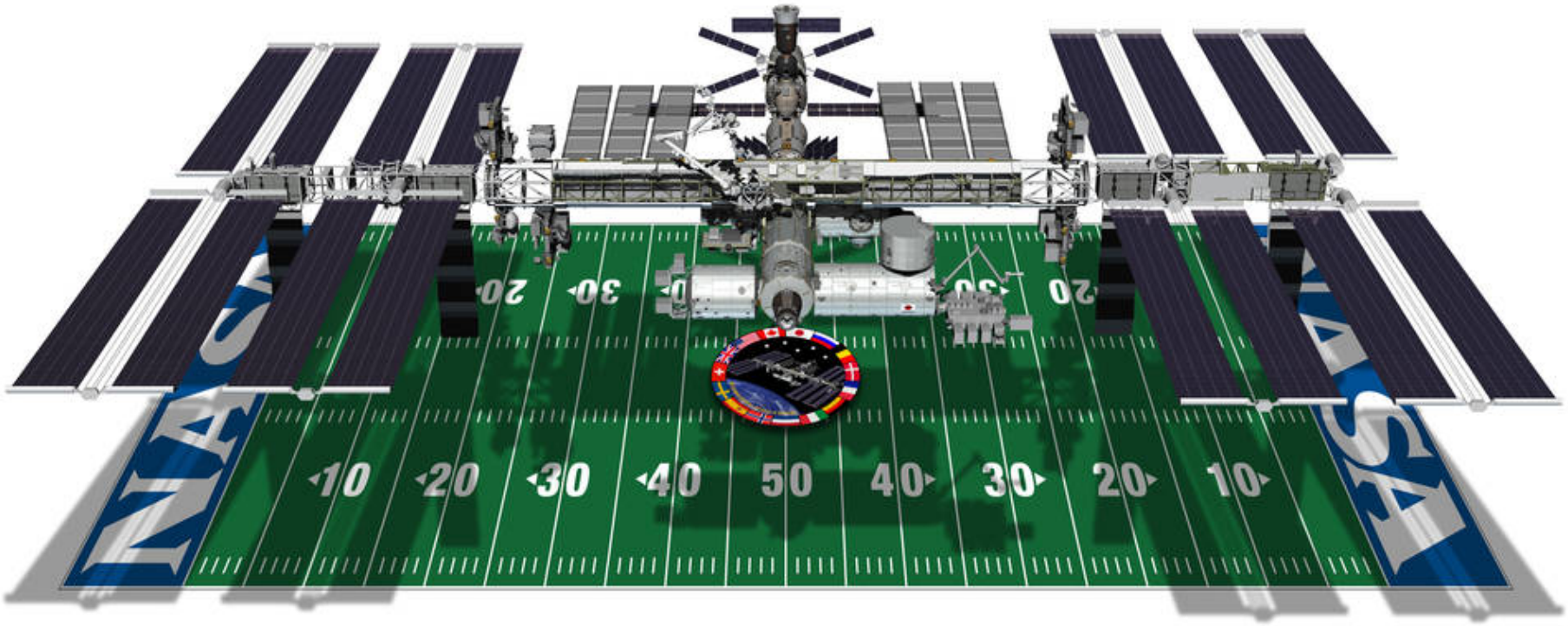
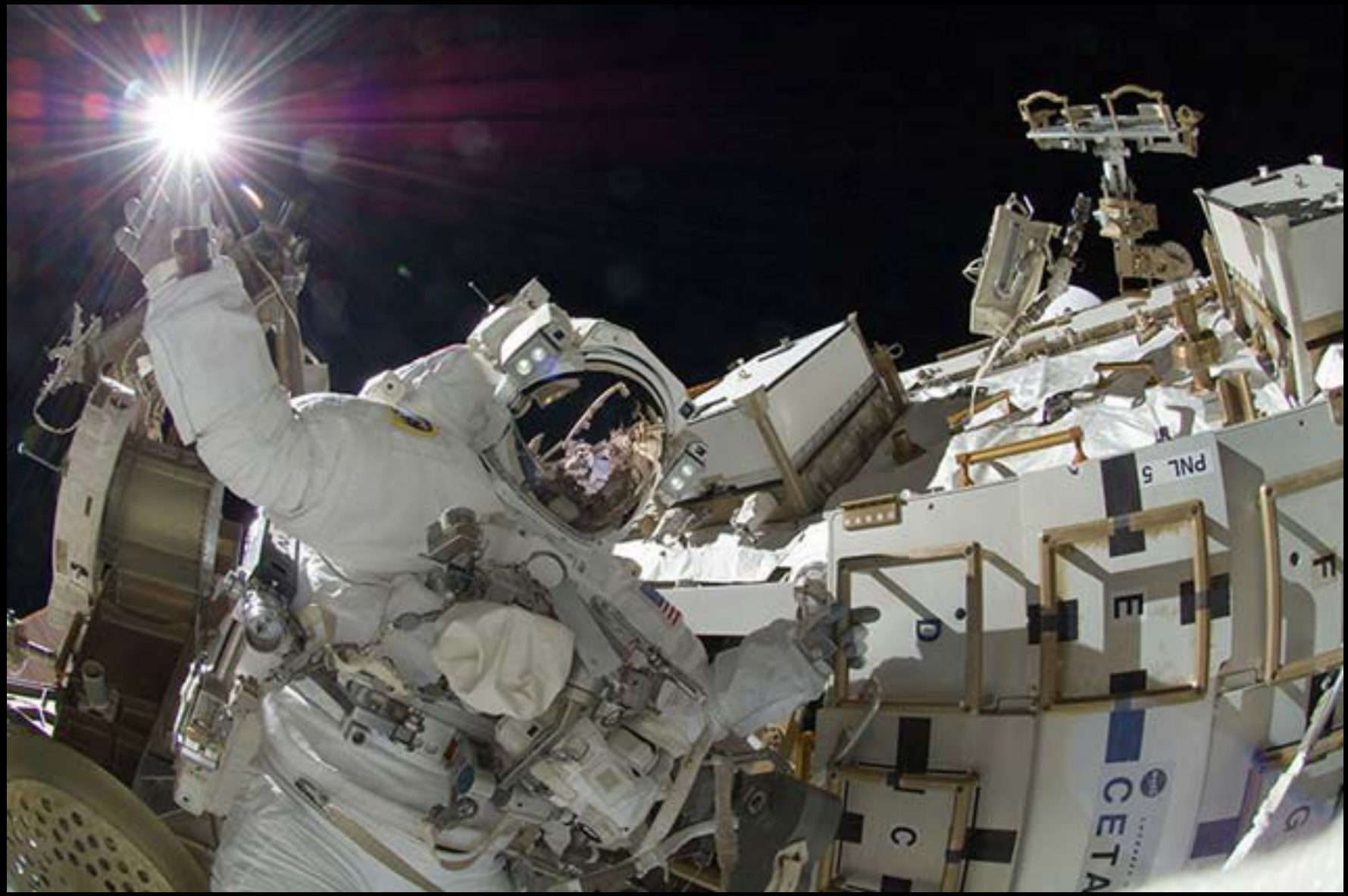


International Space Station

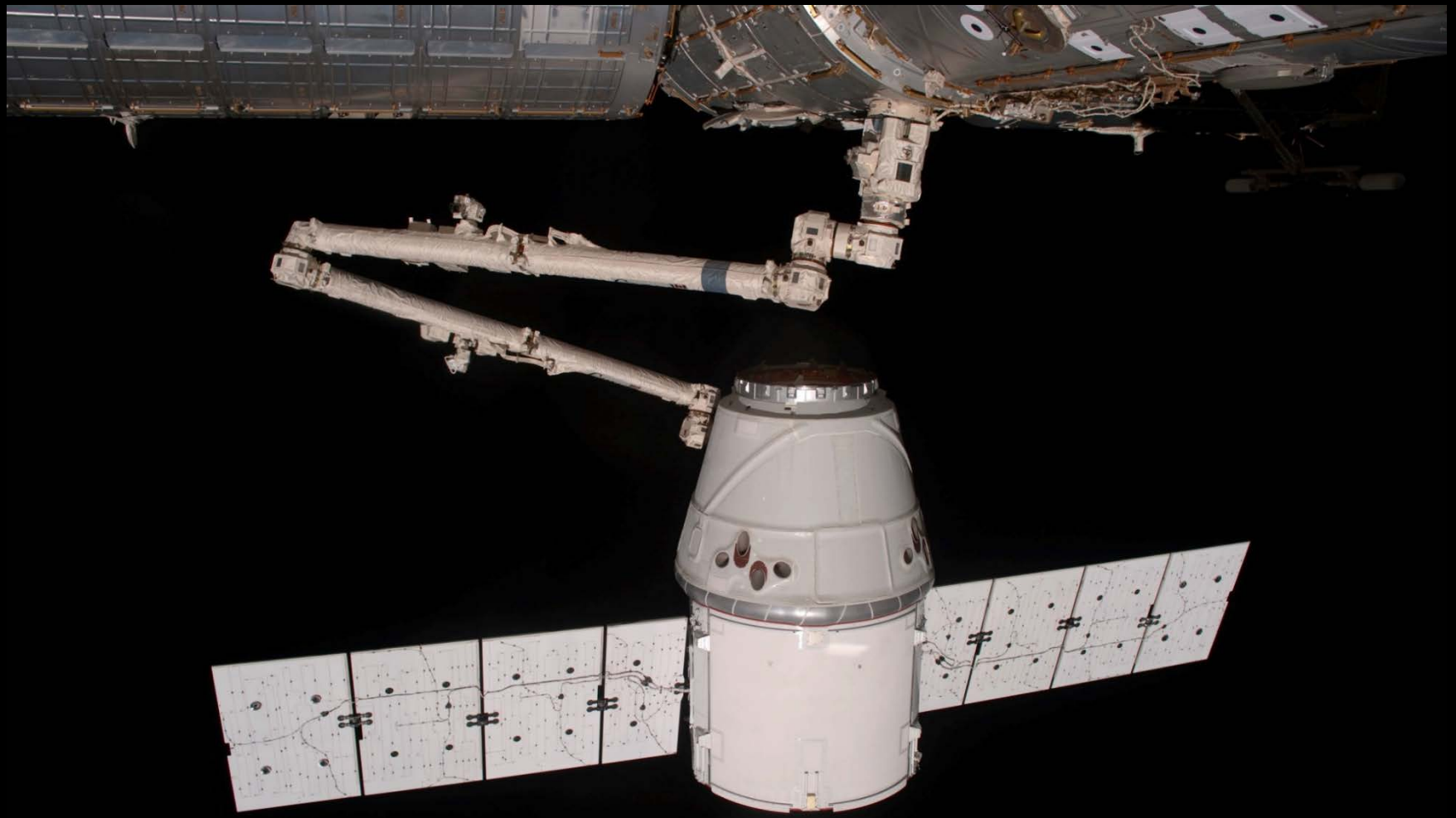


Complex Operations Dependent on Human Involvement

Repair and Maintenance Operations in a Hostile Environment

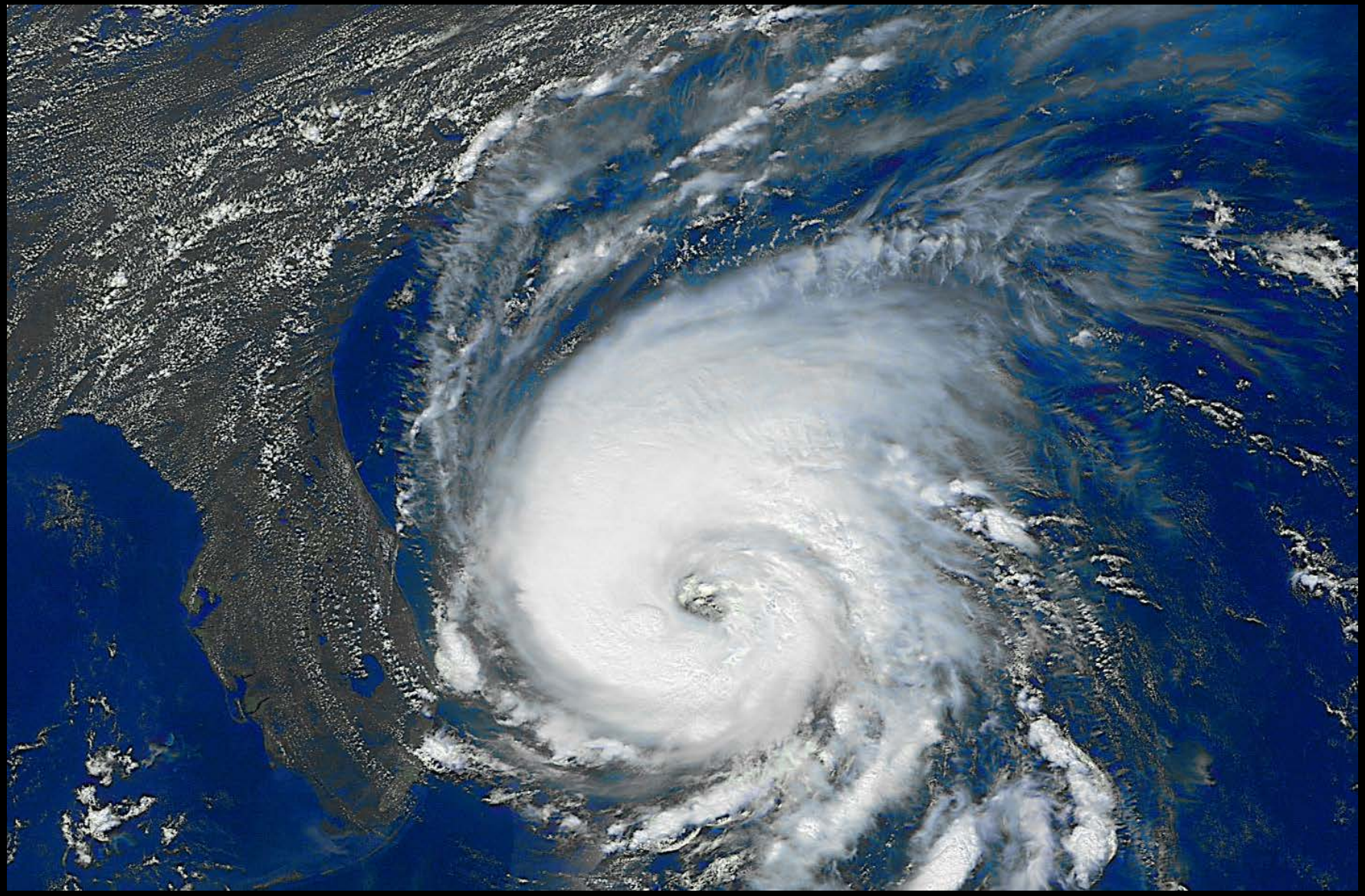


Ongoing Resupply Operations



ISS Mission Control Center

Isolated and Not Easily Accessible



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Qualitative versus Quantitative Risk Assessment

QUALITATIVE risk assessment is commonly based on experience or expertise and results in categorical estimates of risk.

QUANTITATIVE risk assessment leverages empirical data to determine and assign numerical values to risk.

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, then we could do standard statistics to estimate the probability of catastrophic failure of a space station

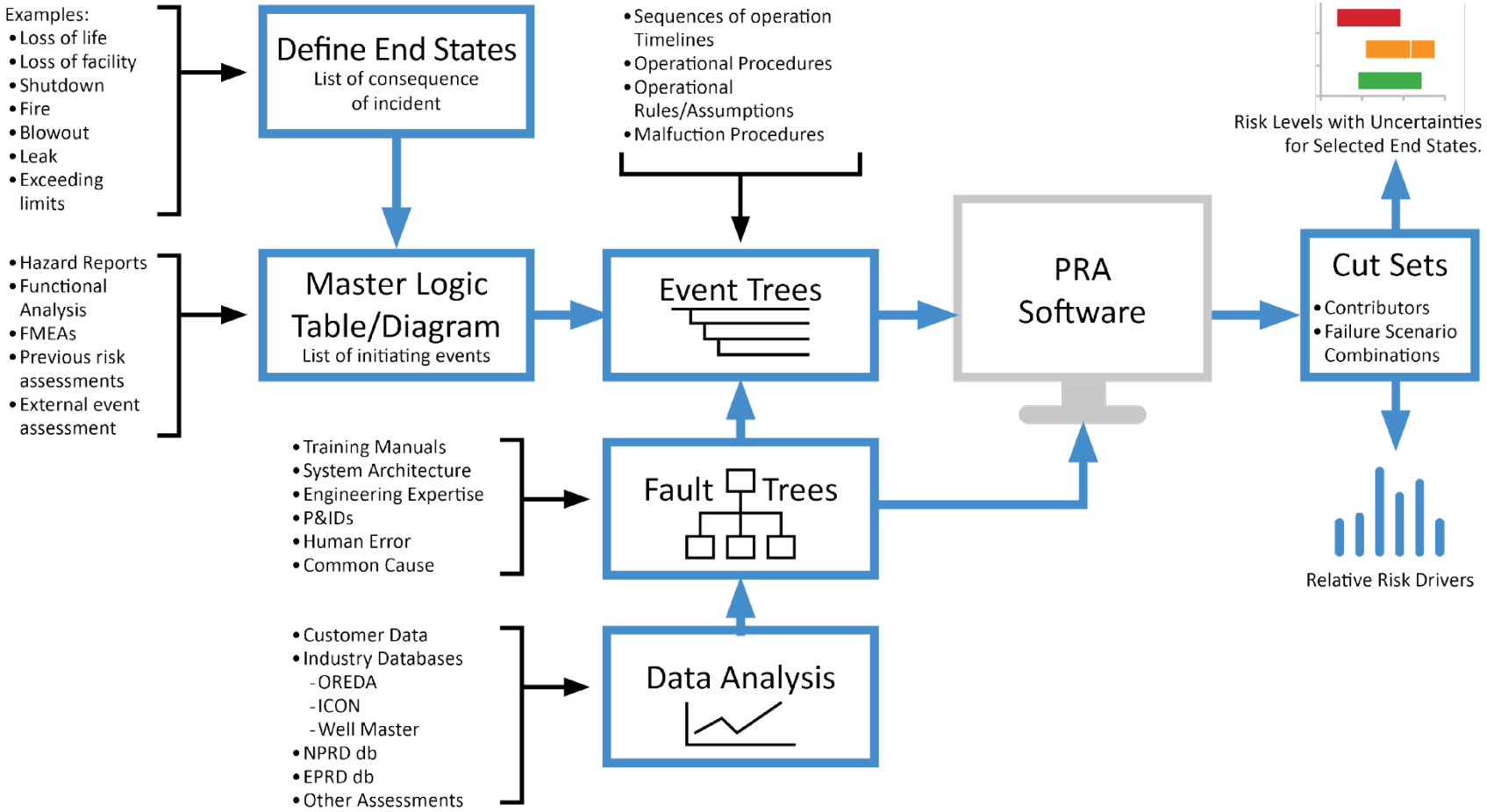
- We have only one space station, and it has had minimal experience and no catastrophic failures. Consequently, there will not often be any statistically significant data.

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.

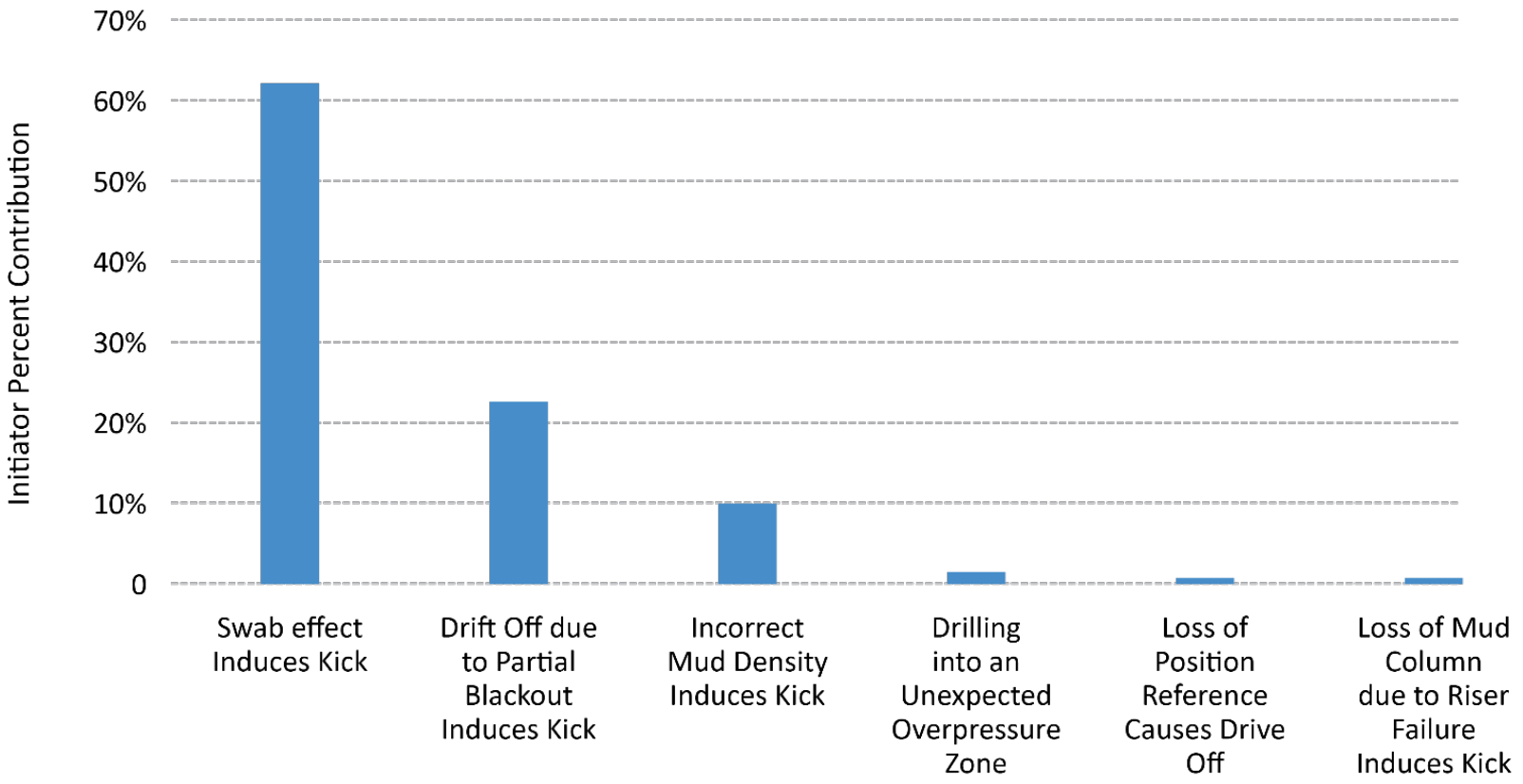
- Human Reliability
- Common Cause

First, Define the “End States” of the PRA Analysis

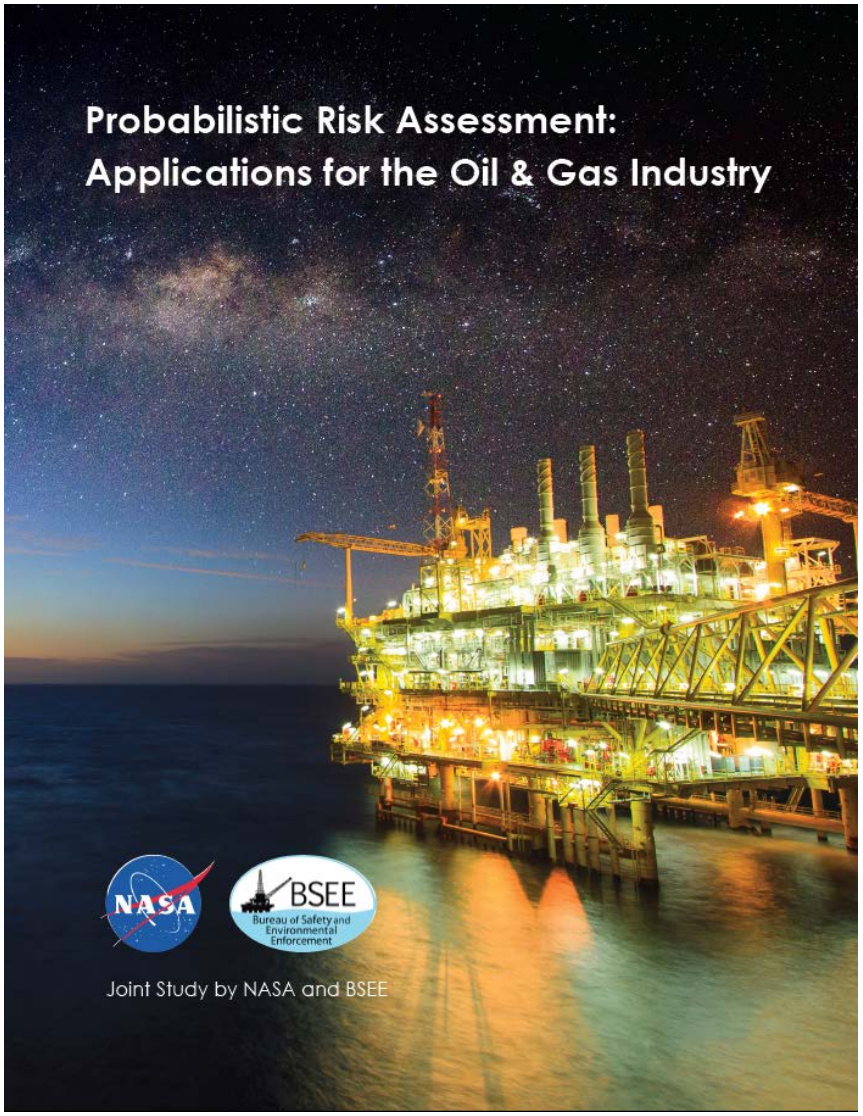
Major Steps to Perform a PRA



Notional Initiating Event Ranking Leading to a Well Kick



Data in this figure does not represent any particular facility. Rankings may be different for slightly different designs or operational procedures/practices.


Probabilistic Risk Assessment:
Applications for the Oil & Gas Industry
NASA
BSEE
Bureau of Safety and Environmental Enforcement
Joint Study by NASA and BSEE

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U.S. Bureau of Safety and Environmental Enforcement

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."

March 17, 2016

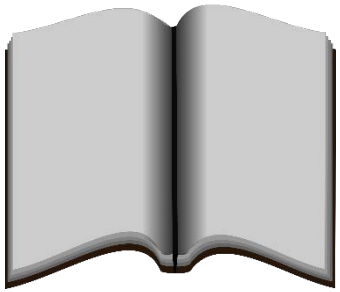
5 Year Agreement

NASA's probabilistic risk assessment technique

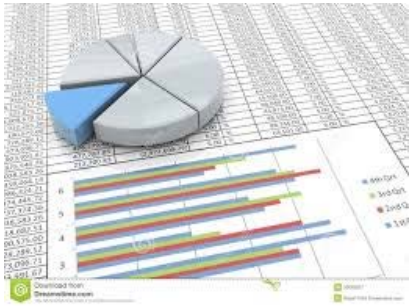
NASA Tasks for 2017

PRA Procedures Guide for Offshore Applications (Rev. 1)
https://www.bsee.gov/what-we-do/offshore-regulatory-programs/risk-assessment-analysis/probabilistic-risk-assessment-analysis

Deep water Drilling PRA



Subsea Production Hardware PRA



PRA Data Needs

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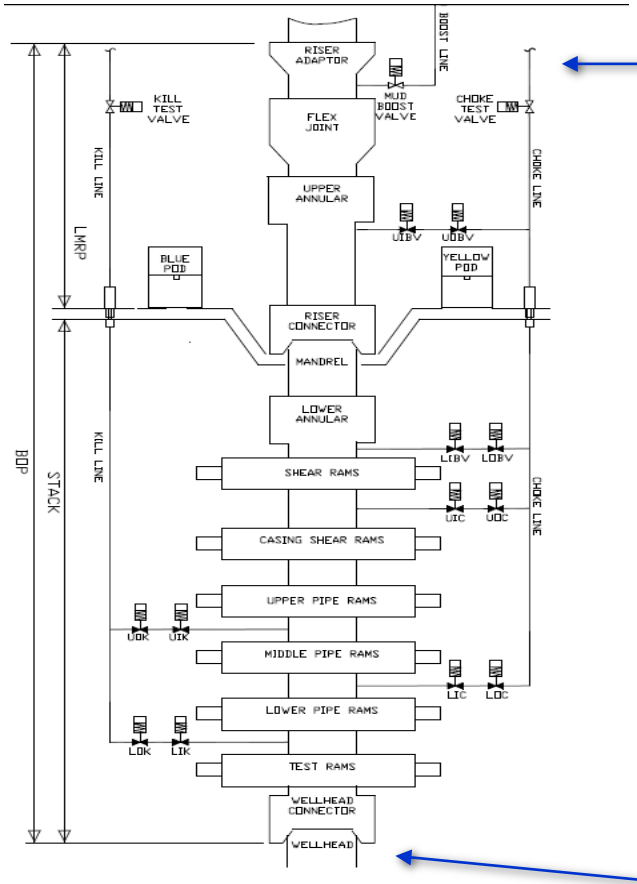
Generic 20,000 psi Blowout Preventer (BOP) Model

<u>End State:</u>
Loss of Containment

<u>Initiating Events:</u>
- Well Kick Occurs
- Loss of Position



- Riser Adapter
- Flex Joint
- Upper Annular
- Riser Connector
- Mandrel
- Lower Annular
- Shear Rams
- Casing Shear Rams
- Upper Pipe Rams
- Middle Pipe Rams
- Lower Pipe Rams
- Test Rams
- Wellhead Connector
- Wellhead

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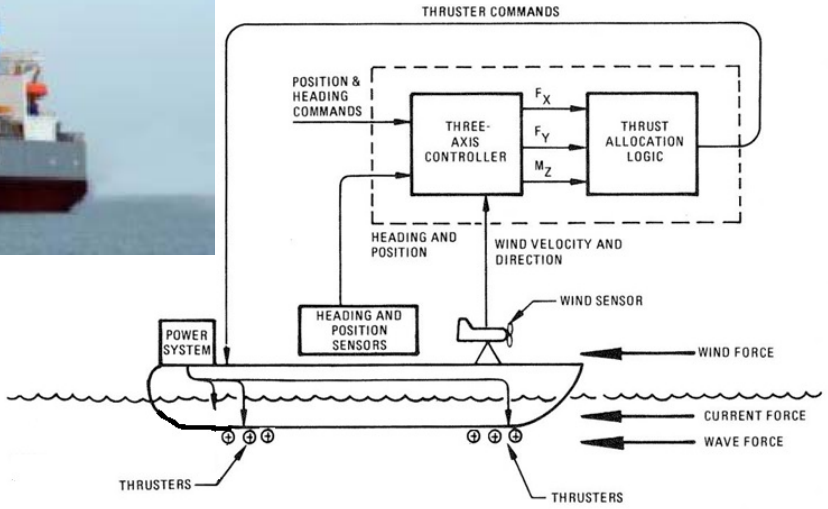
Anadarko Petroleum Corporation

Dynamic Positioning System (DPS) Model

Class 3 Drilling Vessel

<u>End State:</u>
Loss of Location

<u>Initiating Events:</u>
- Drift-off
- Drive-off
- Push-off



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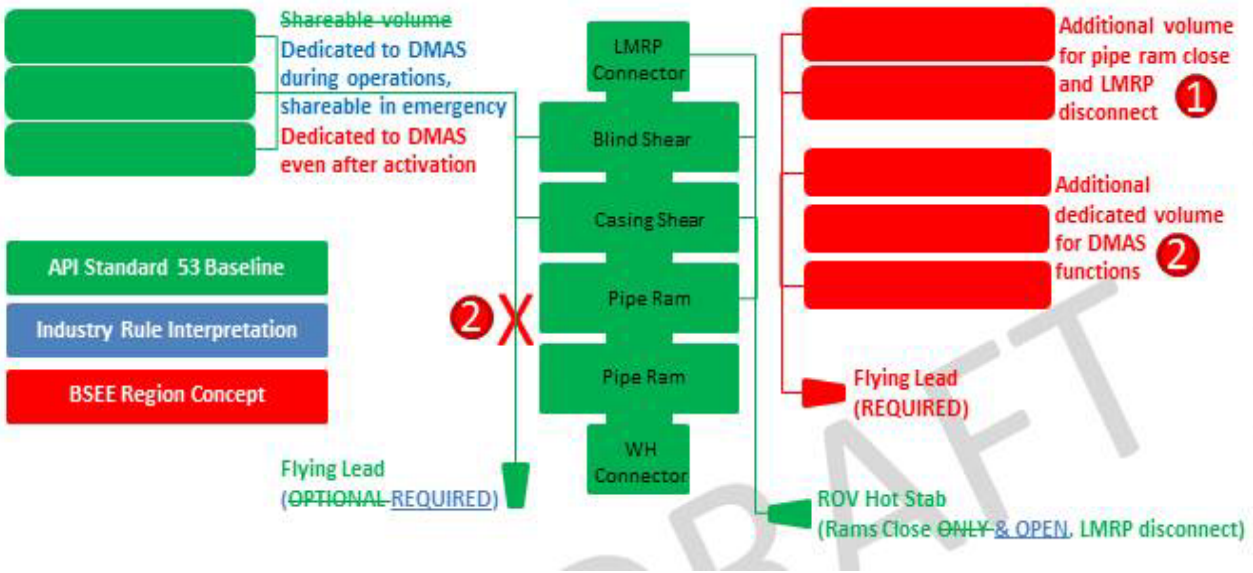
BSEE Well Control Rule Subsea Accumulator Requirement Configuration



New *Well Control Rule* from BSEE [30 CFR 250.734 (a)(3)] will require additional subsea accumulator volume for hydraulic fluids.

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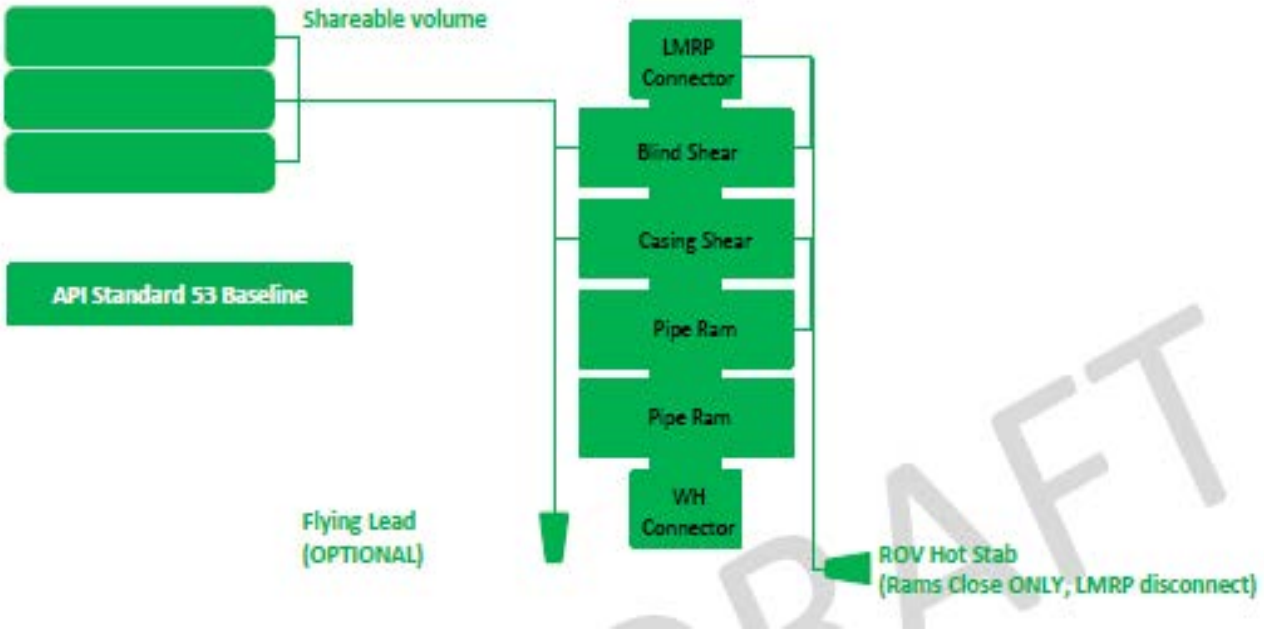
API Standard 53 Subsea Accumulator Configuration



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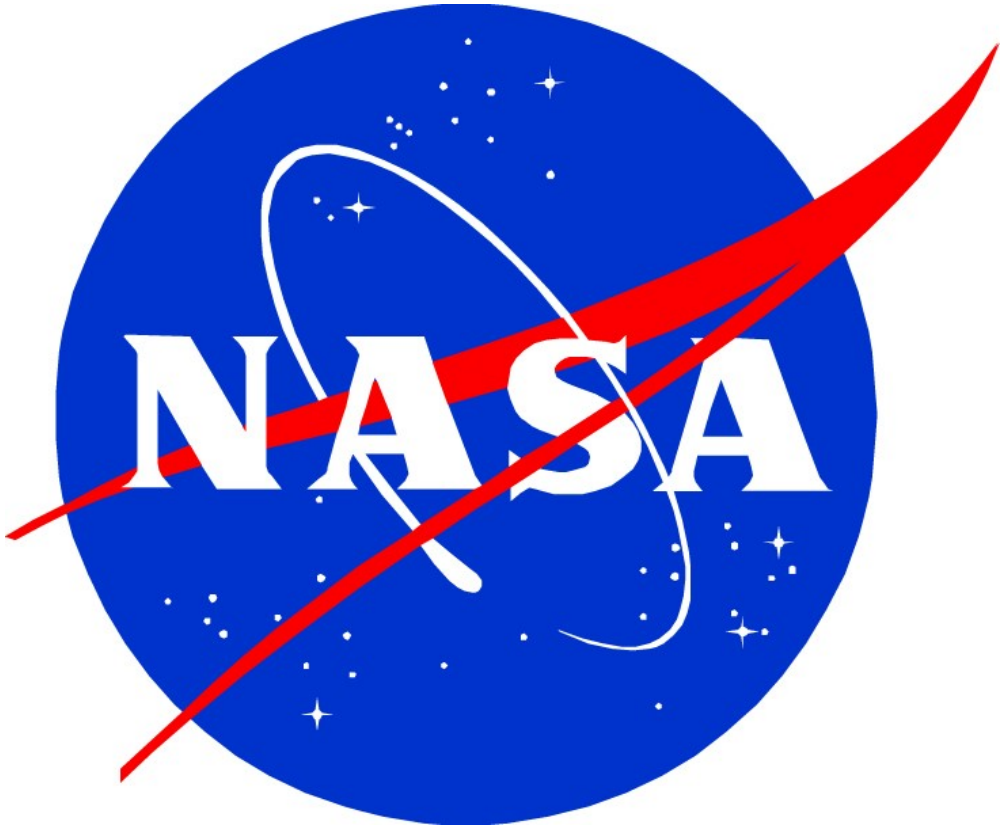
NASA