



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

## ***ARCTIC OFFSHORE REGULATORS' FORUM***

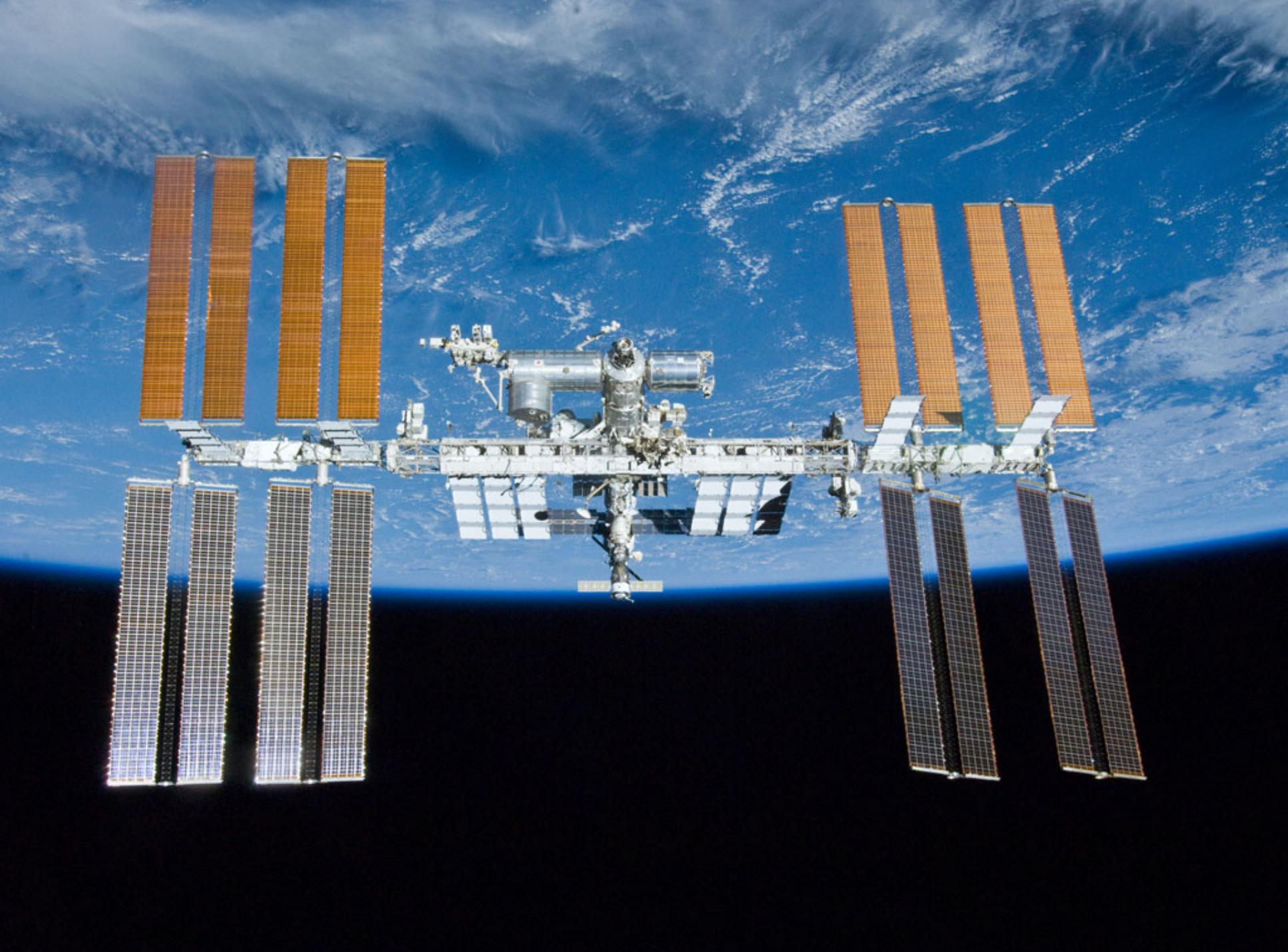
April 29, 2016

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# International Space Station



Visitors to the International Space Station by Country

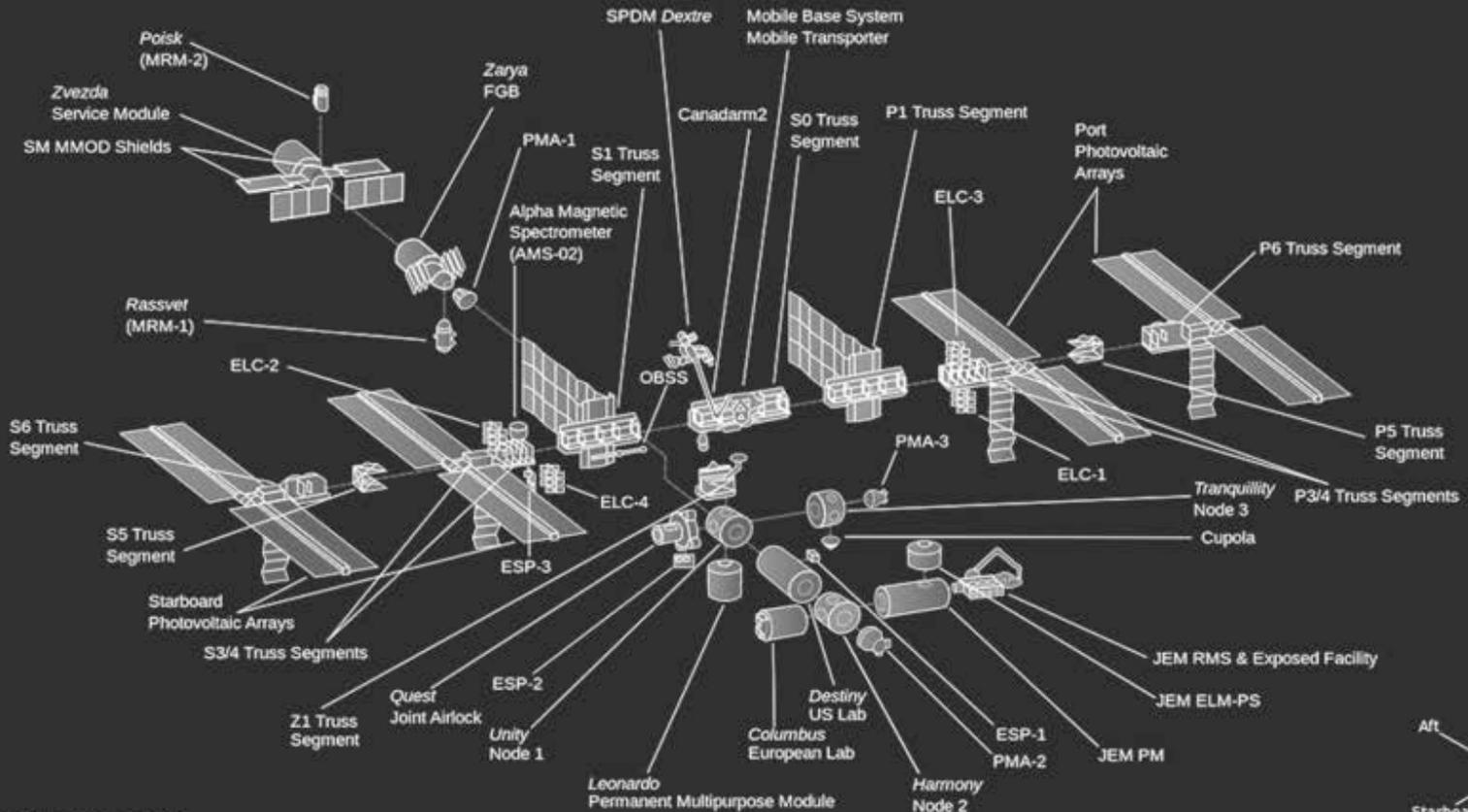


# International Space Station



## ISS Configuration

As of May 2011 (ULF6 - STS-134)



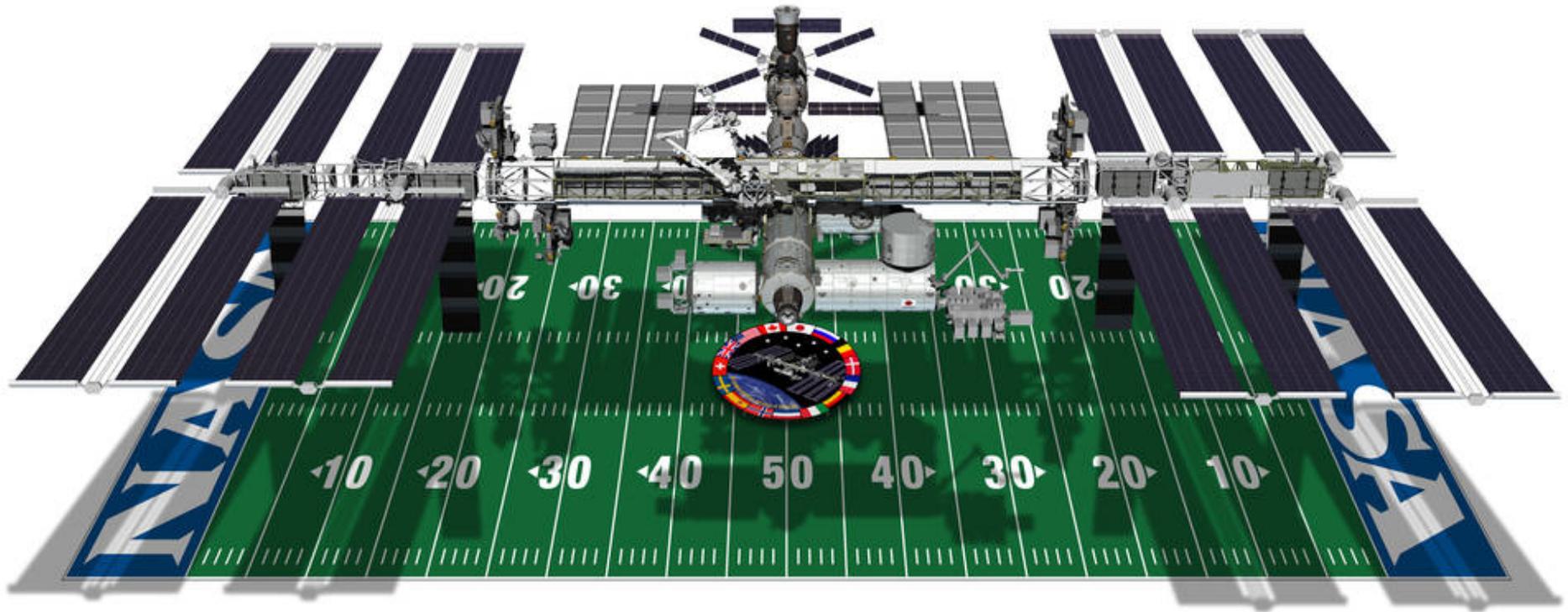
■ Elements Currently on Orbit



# International Space Station Assembly



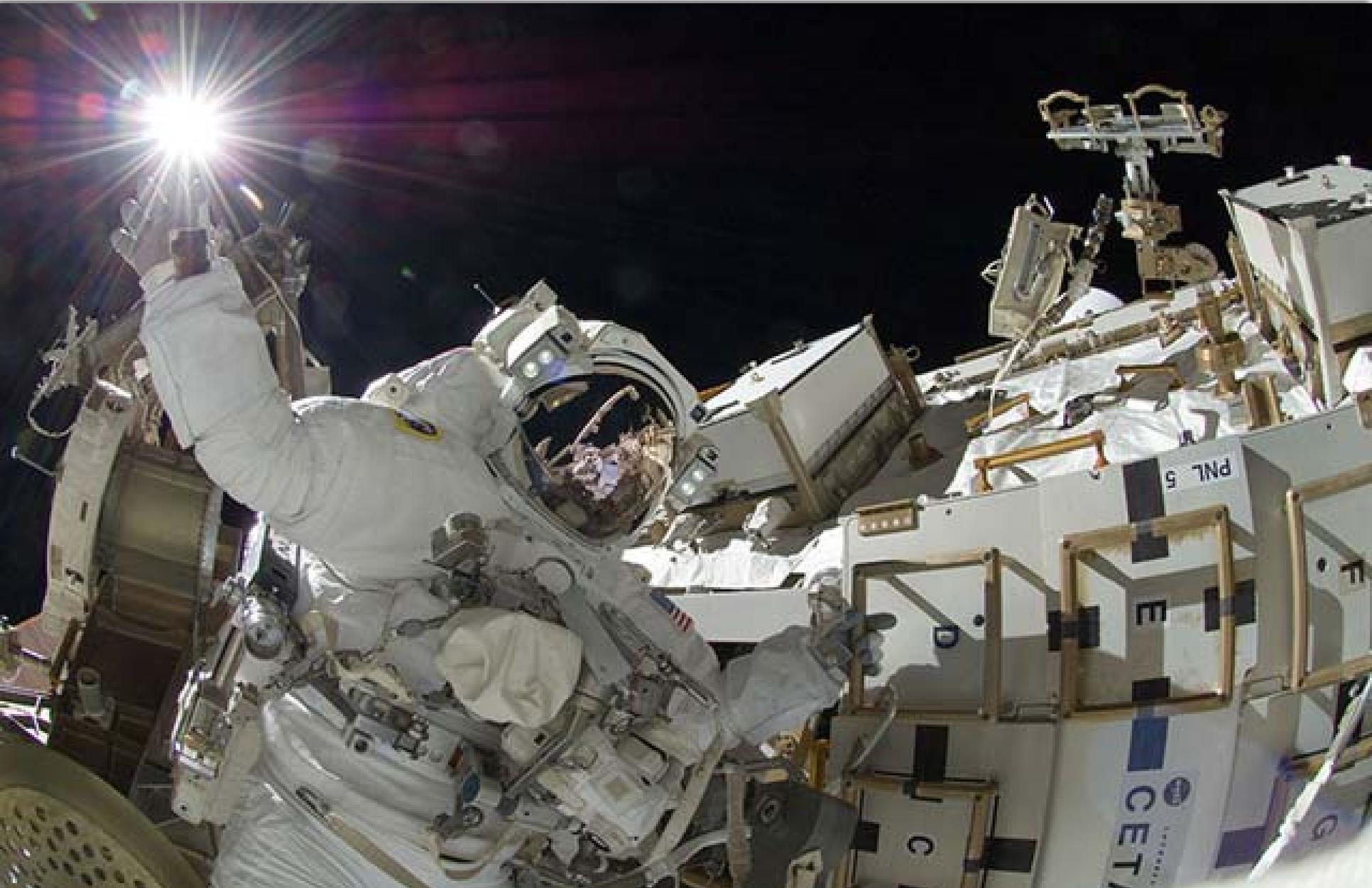
# International Space Station



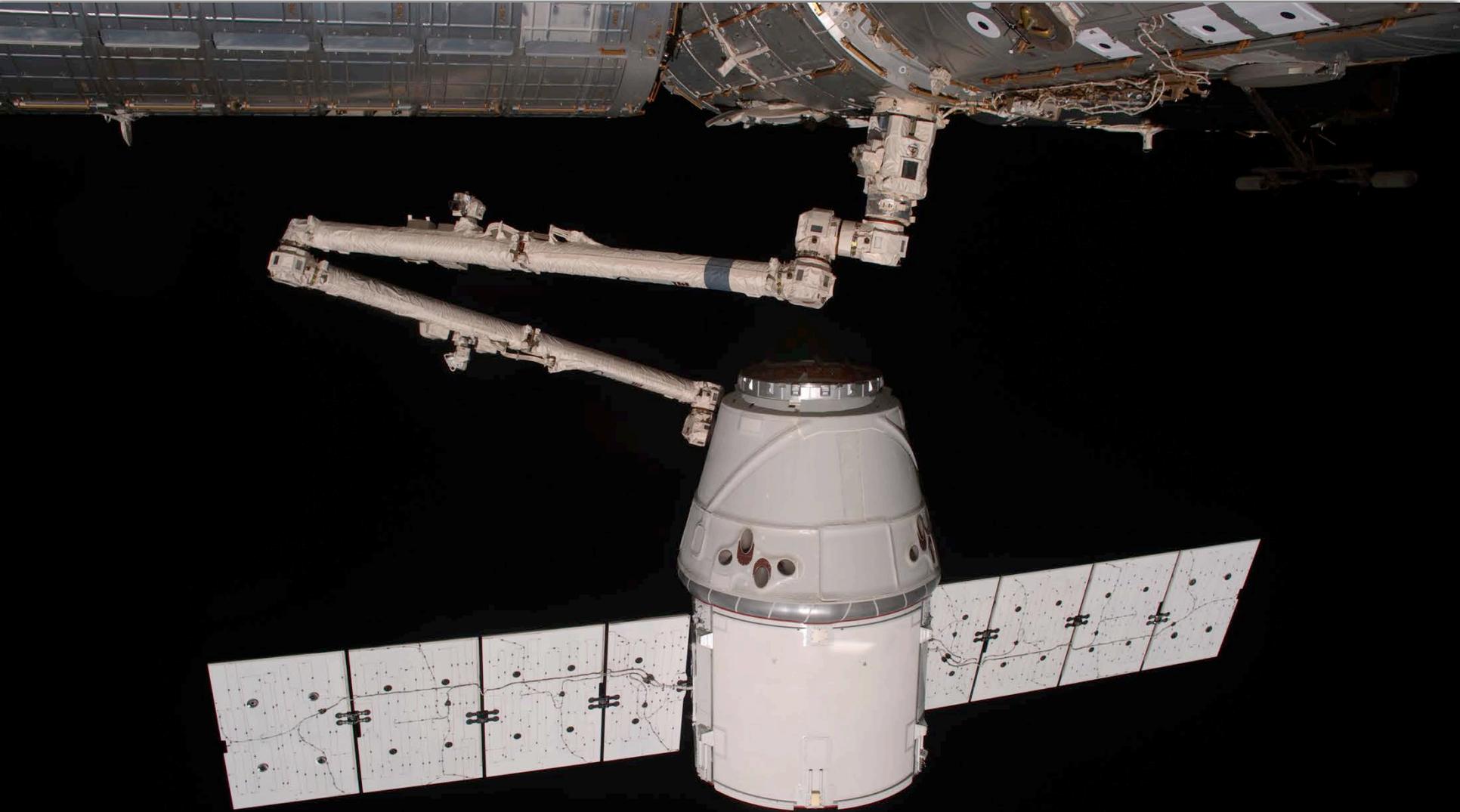
# Complex Operations Dependent on Human Involvement



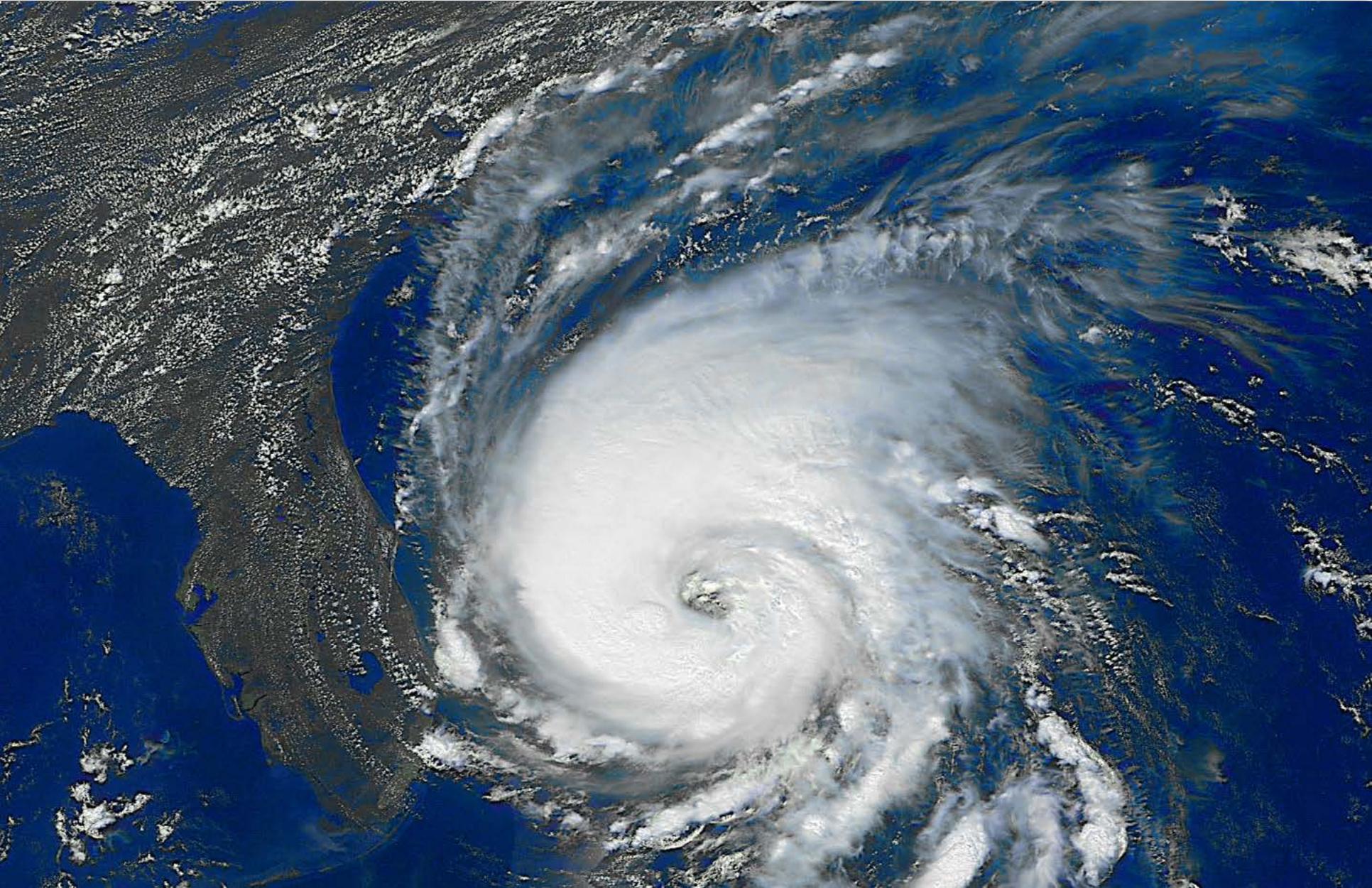
# Repair and Maintenance Operations in a Hostile Environment



# Ongoing Resupply Operations



**Isolated and Not Easily Accessible**





NASA/SP-2011-3421  
Second Edition  
December 2011

**Probabilistic Risk Assessment  
Procedures Guide for NASA  
Managers and Practitioners**

“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

# History of PRA: Nuclear Power Industry



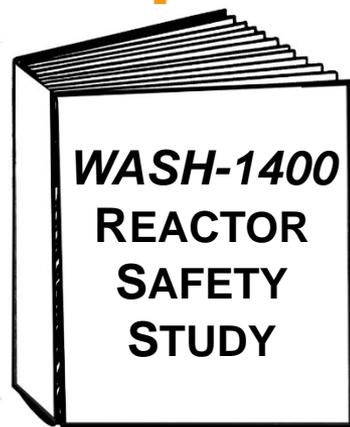
Three Mile Island Accident  
March 28, 1979

1970

1975

1980

1st PRA :



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



Space Shuttle **COLUMBIA**  
February 3, 2003

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

Space Shuttle

International Space Station

Constellation Program

ExtraVehicular Activity (EVA)

Orion Capsule

Commercial Crew



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.



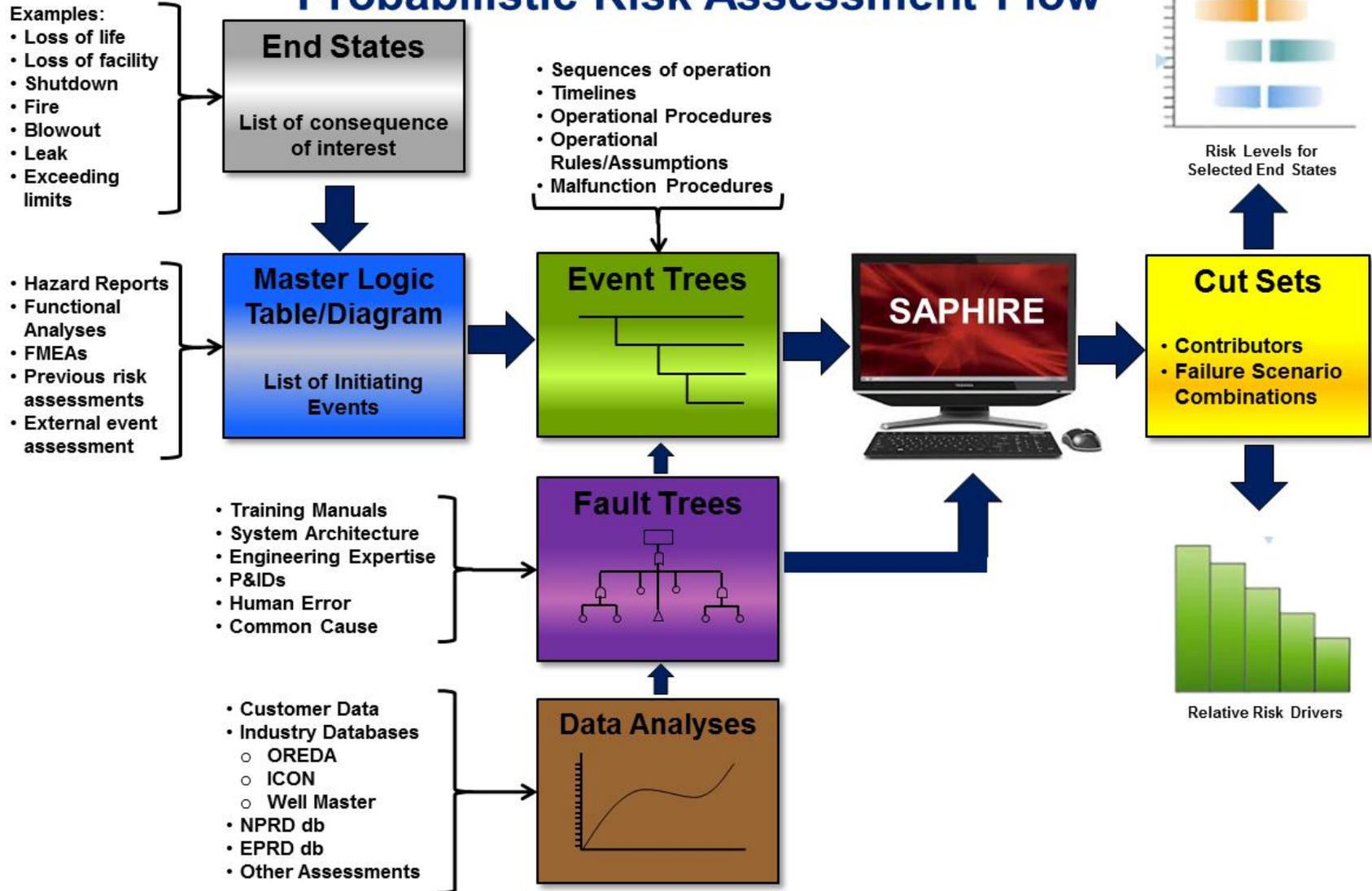
PRA's systematically connect design, logic, operations, human interaction and external influences for all aspects of large complex machines/processes to detect dependencies and effects that the human mind just could not track and grasp on its own.

- 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

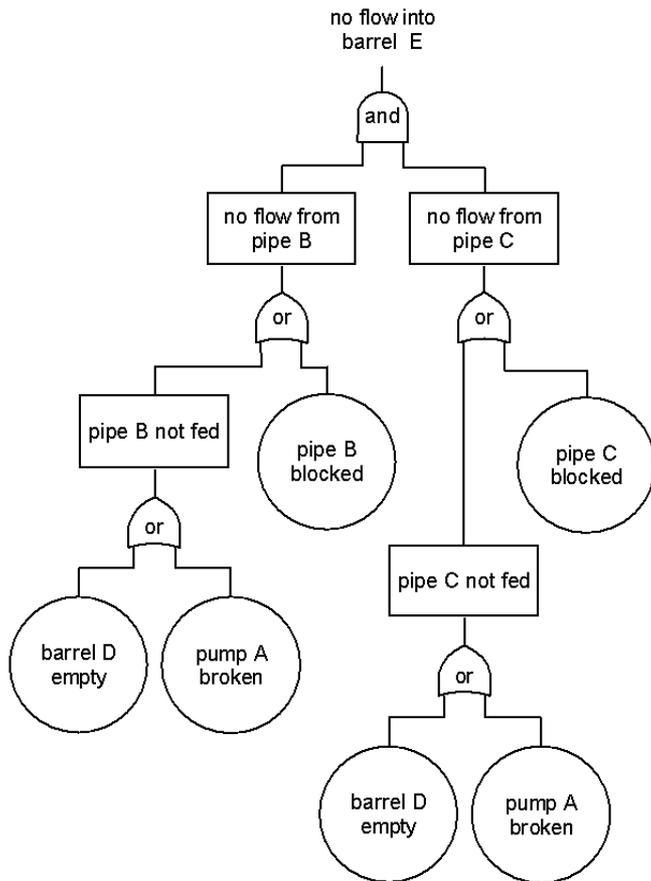
# Probabilistic Risk Assessment (PRA)



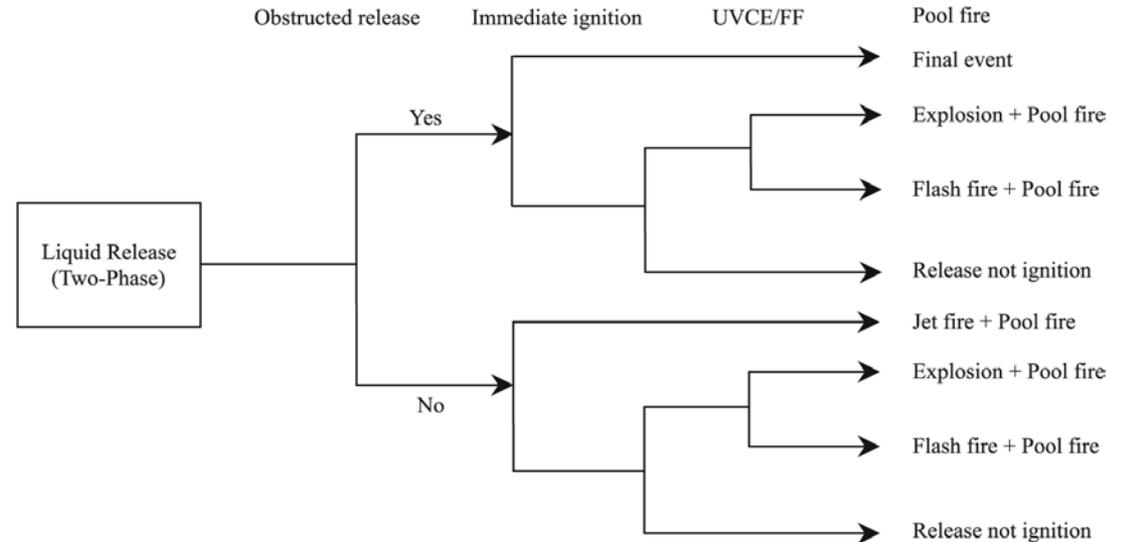
## Probabilistic Risk Assessment Flow

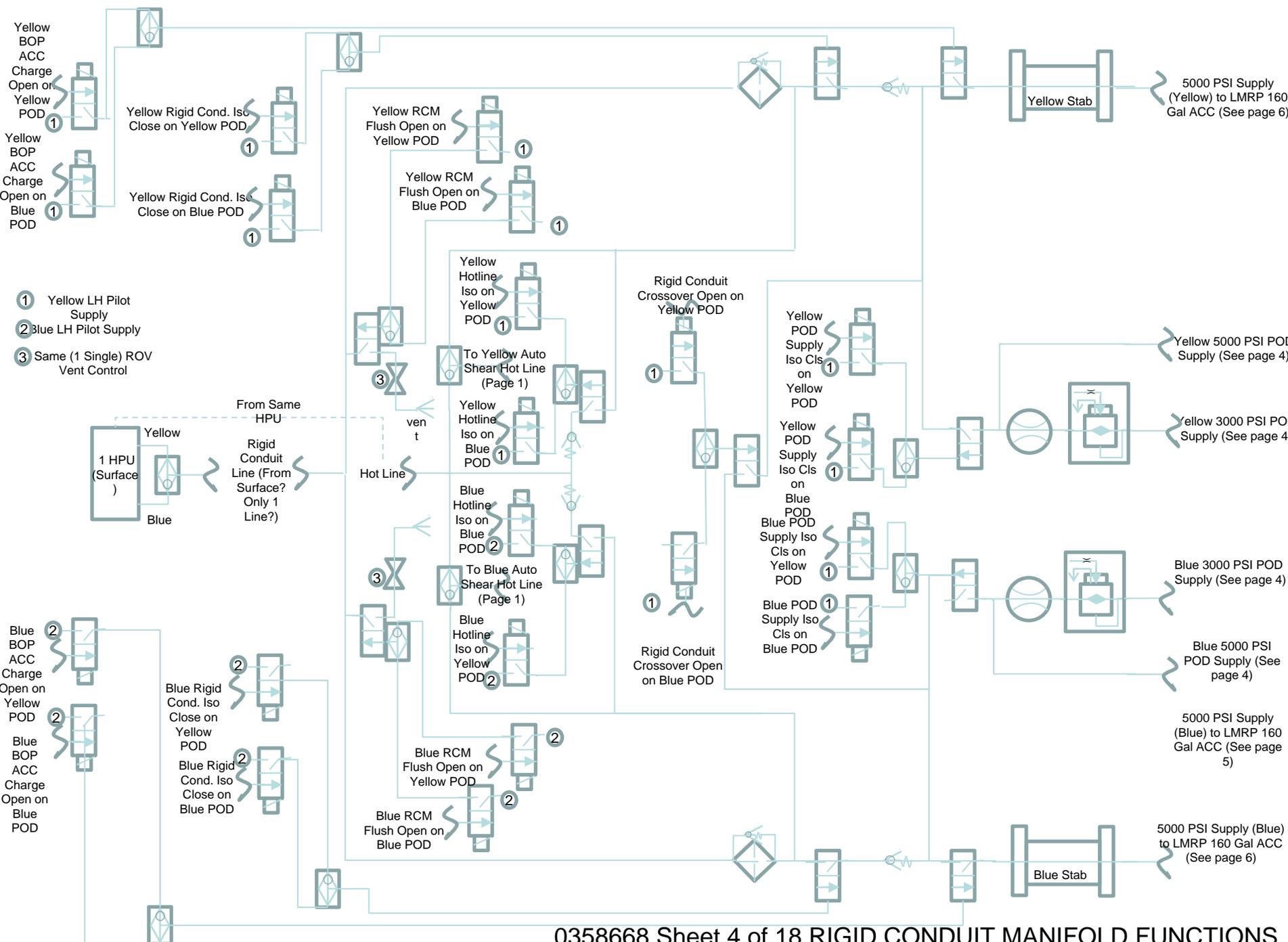


## Fault tree



## Event tree

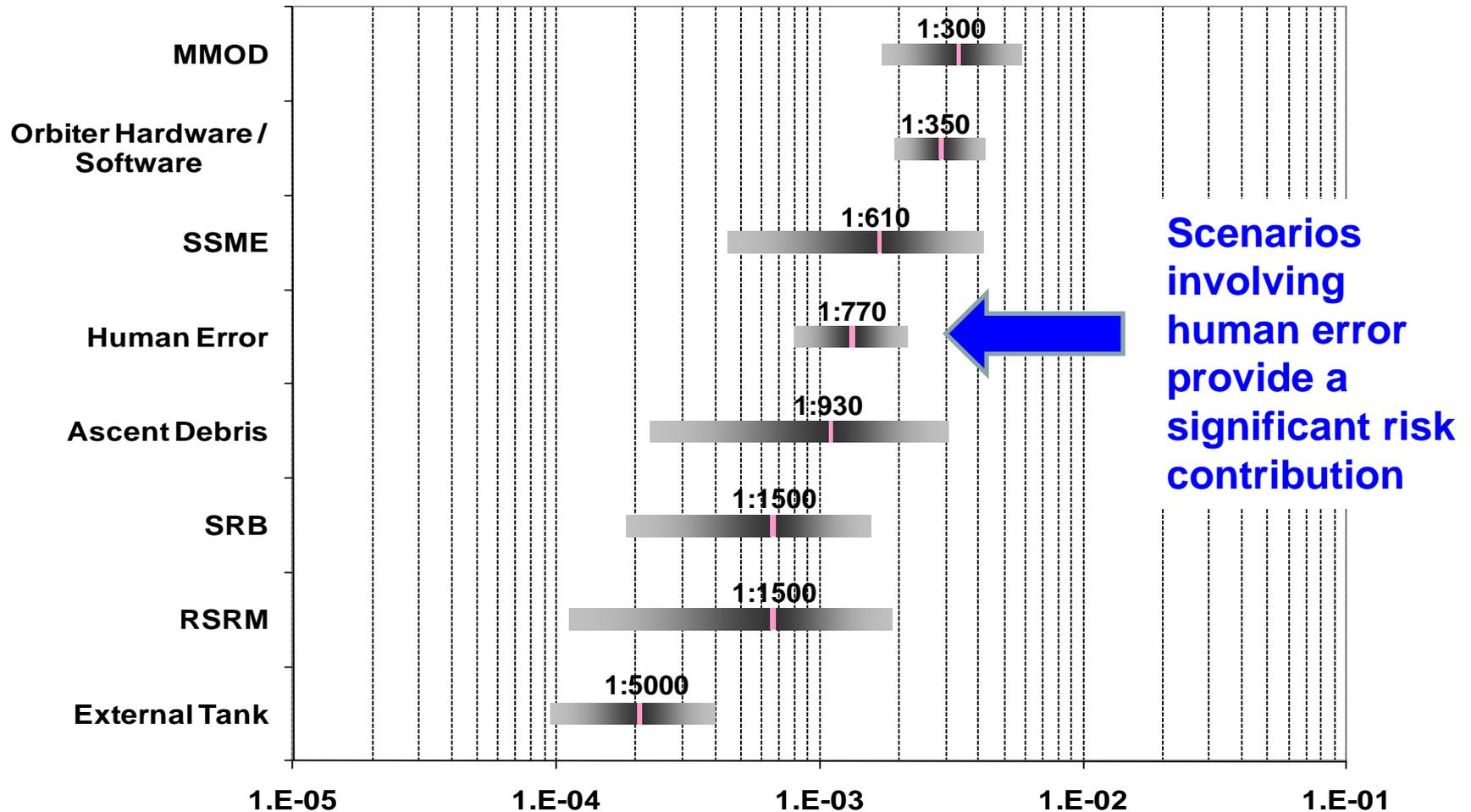




# Space Shuttle Program PRA



## SHUTTLE PRA ITERATION 3.2 CONTRIBUTIONS BY ELEMENT OR MAJOR AREA



# NASA – BSEE Interagency Agreement



✓ Operating Status

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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.

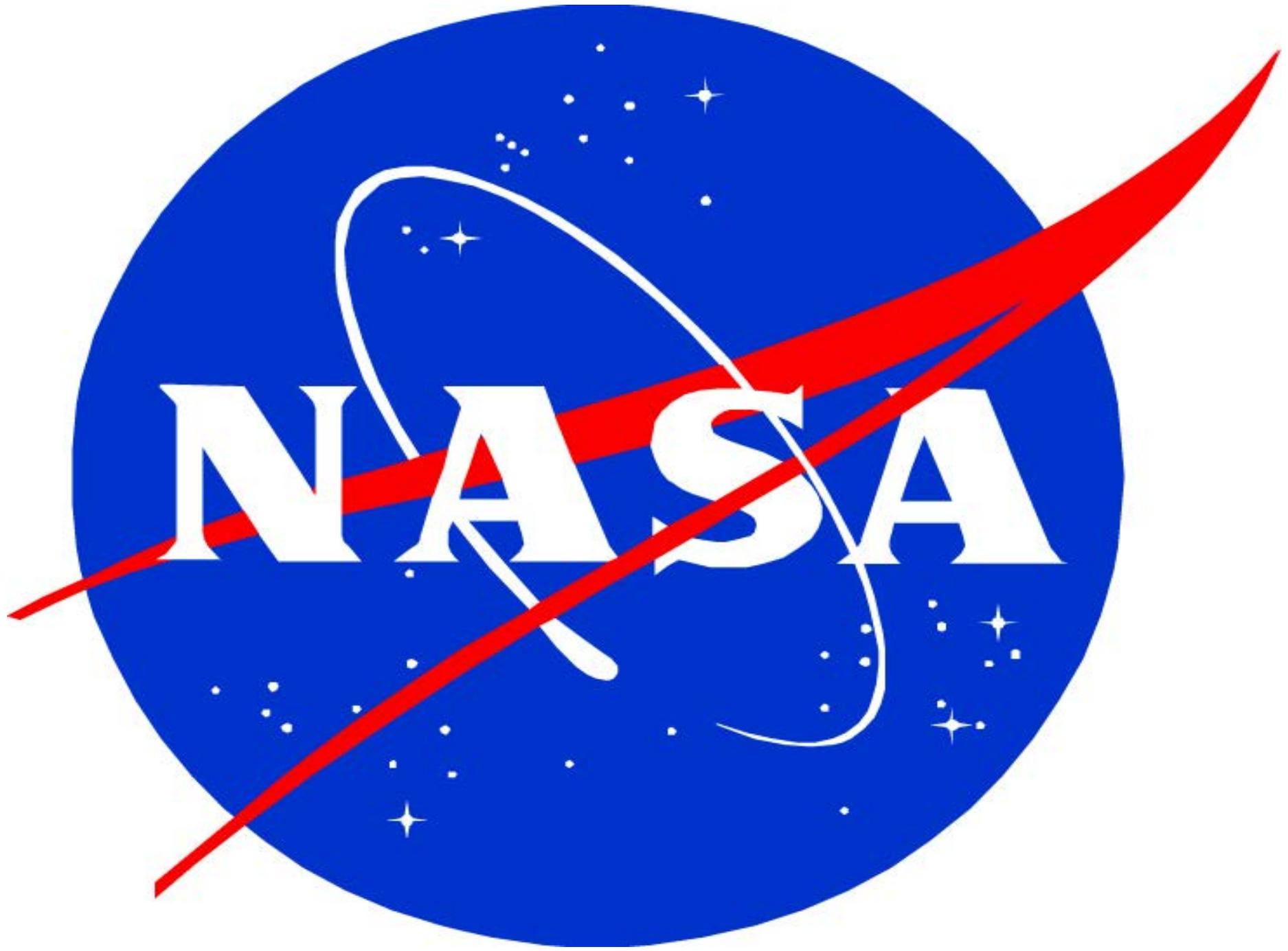
"Both BSEE and NASA work in harsh and uncompromising environments, relying on cutting edge technology to go deeper and further than previously thought possible," said BSEE Director Brian Salerno. "This partnership brings together technical experts from BSEE and NASA to focus on the specific risks associated 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.

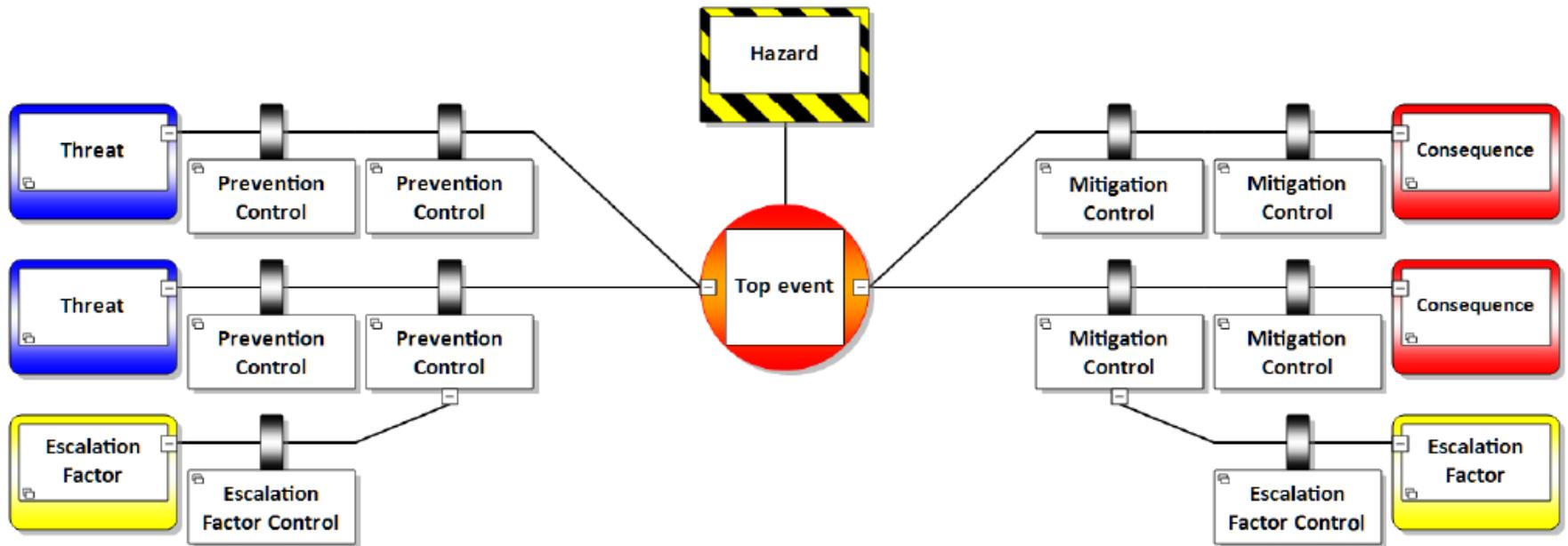
"Whether the task takes one to deep space, or into the deep ocean, the analysis of the environment, training of personnel and risk mitigation factors are similar," said Jack James, technology transfer strategist at the Johnson Space Center. "NASA is pleased to work with BSEE, and we endeavor to learn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







# Basic BowTie



# Deepwater Horizon 8 Key Findings

