



# NASA Probabilistic Risk Assessment Applied to Generic 20K Blowout Preventer (BOP)

## ***IADC WELL CONTROL CONFERENCE***

August 29, 2017

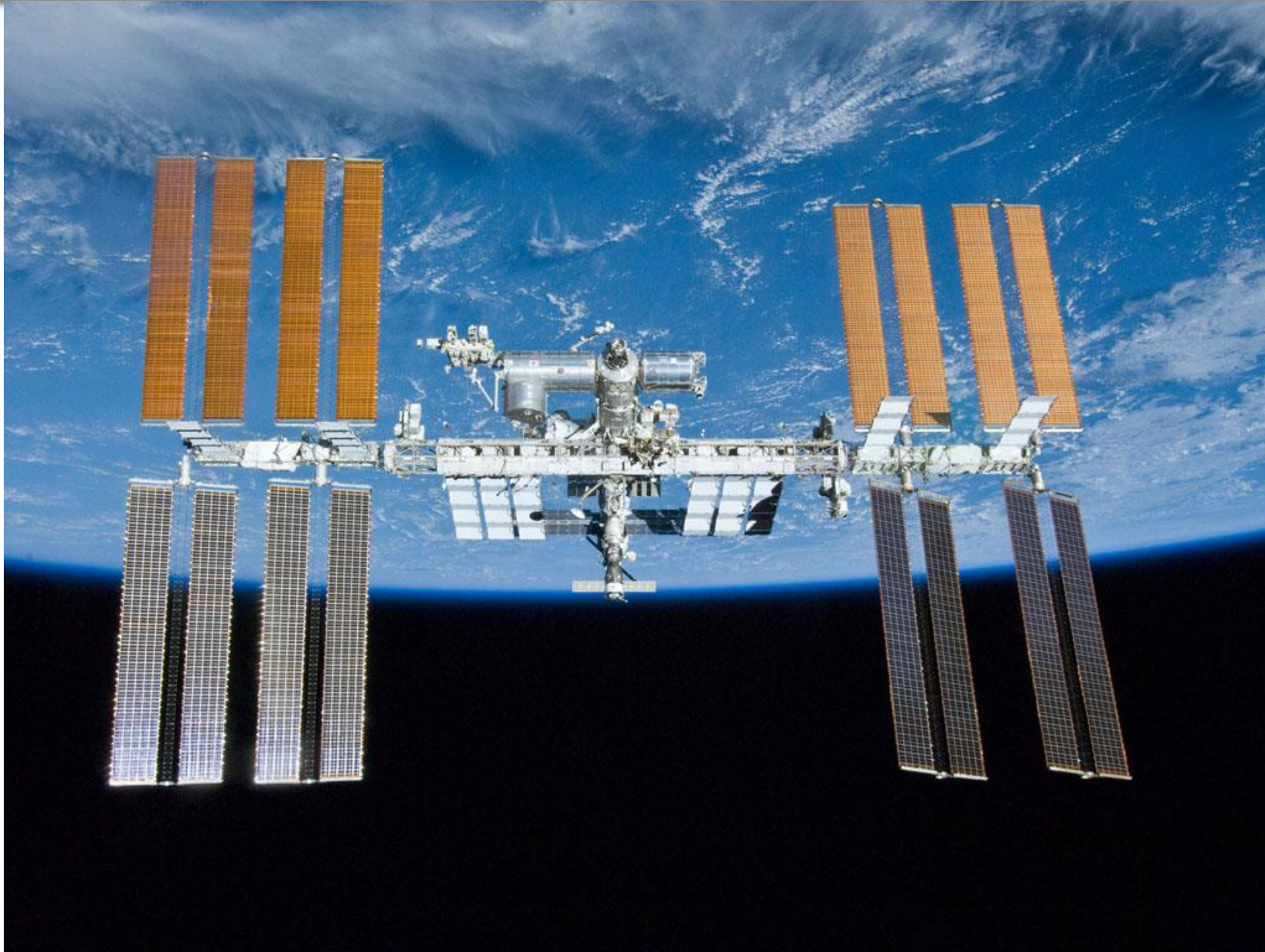
David Kaplan

NASA/Johnson Space Center

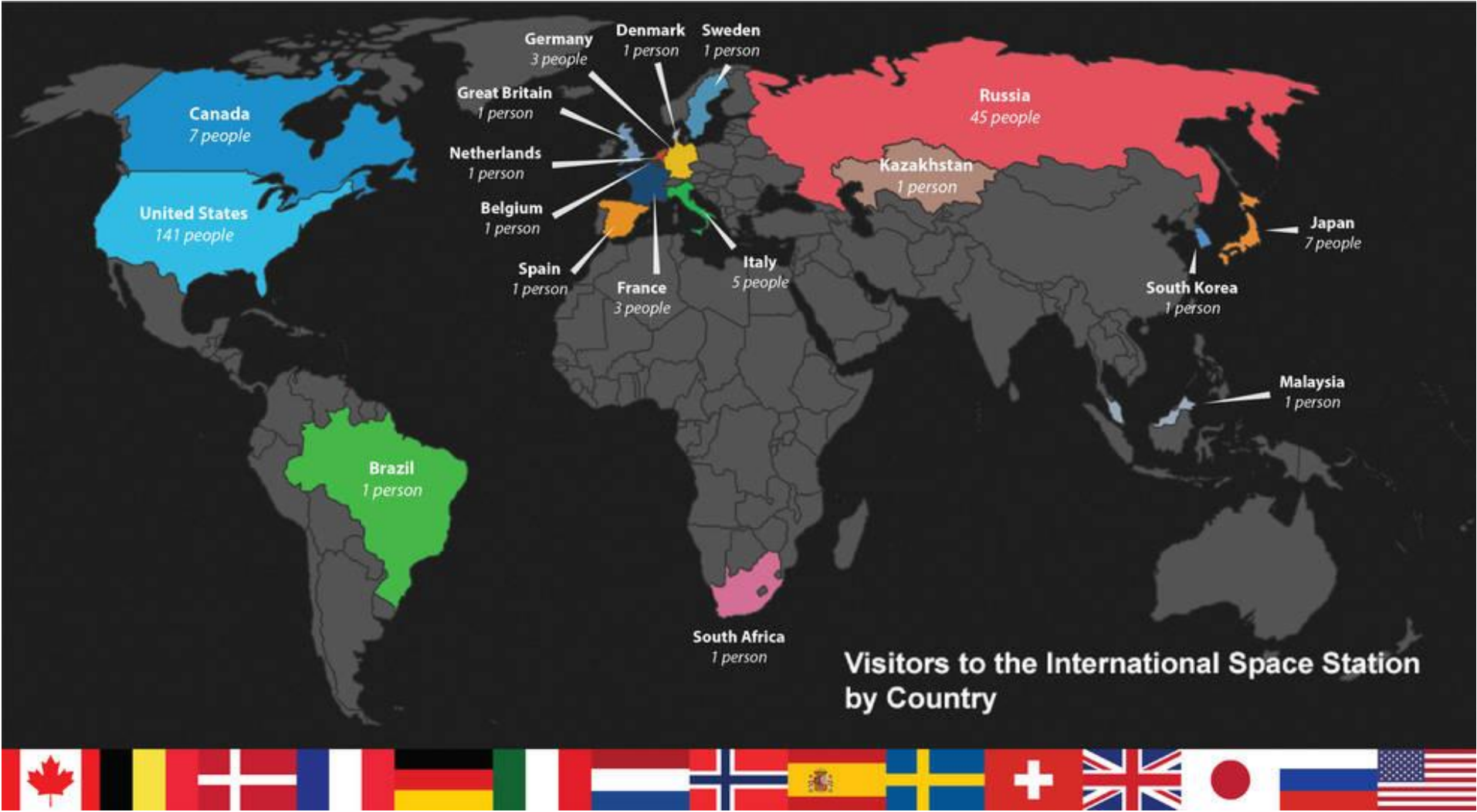
*david.i.kaplan@nasa.gov*



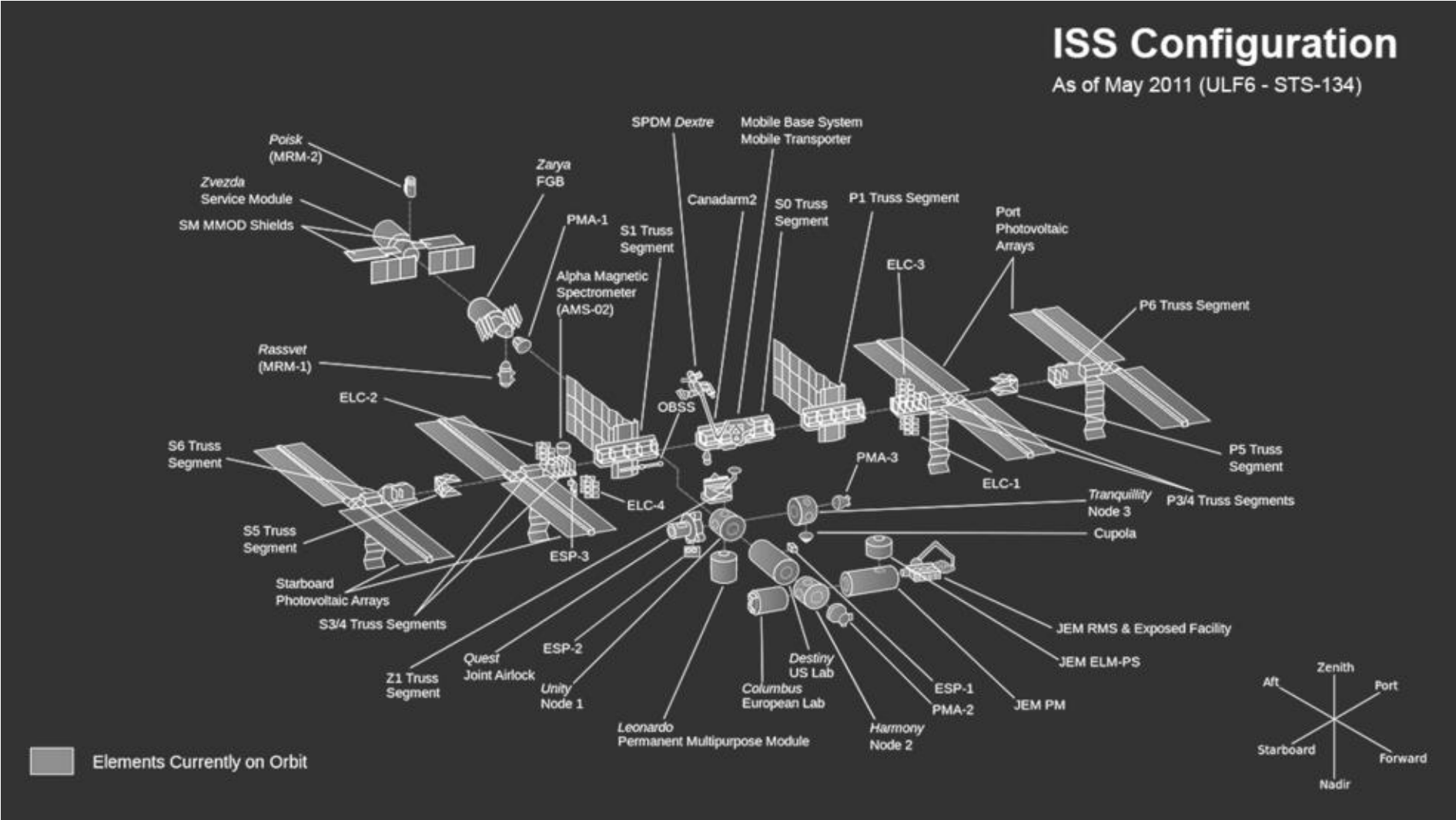
# International Space Station



# International Space Station



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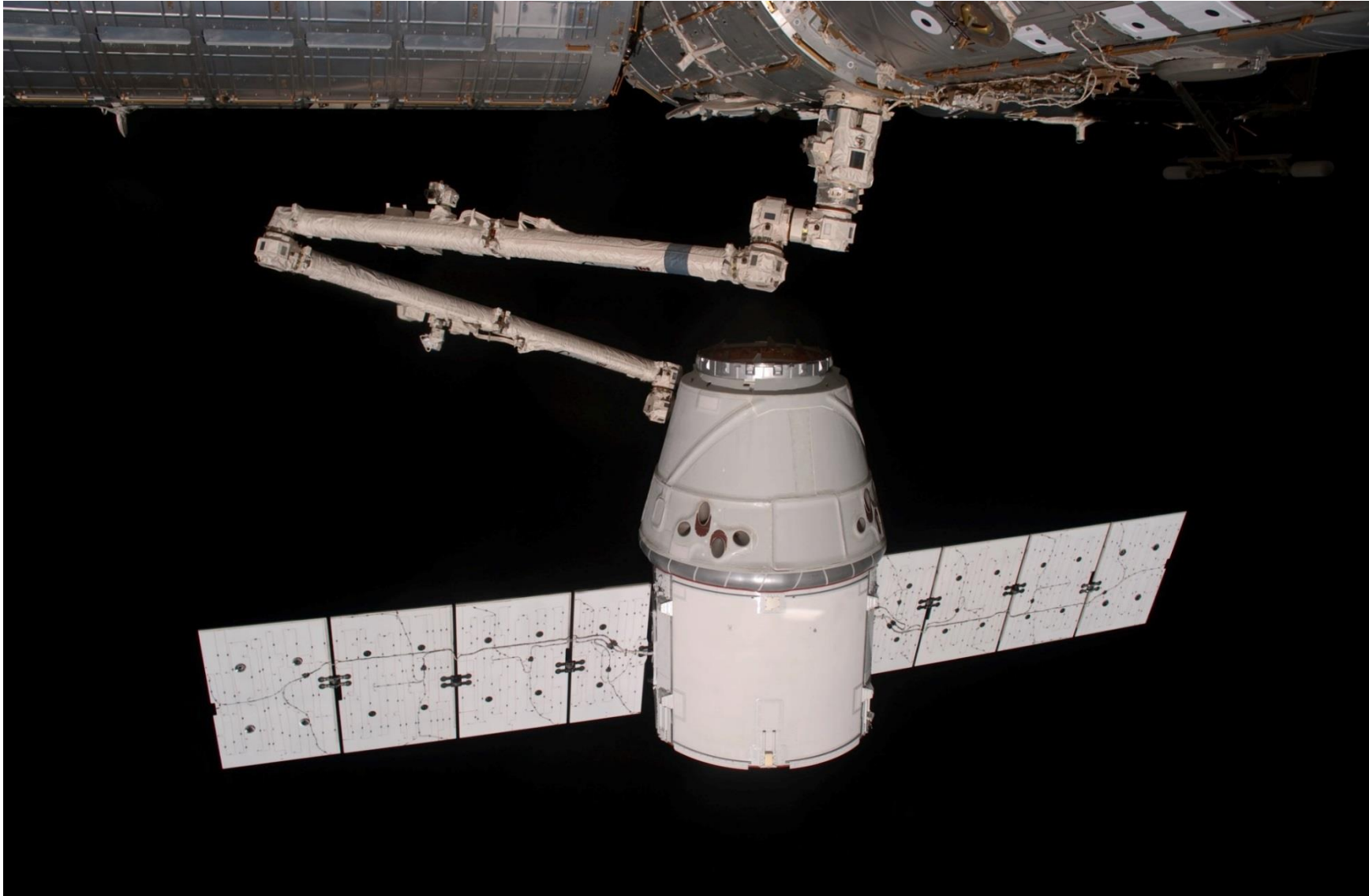
# Complex Operations Dependent on Human Involvement



# Repair and Maintenance Operations in a Hostile Environment

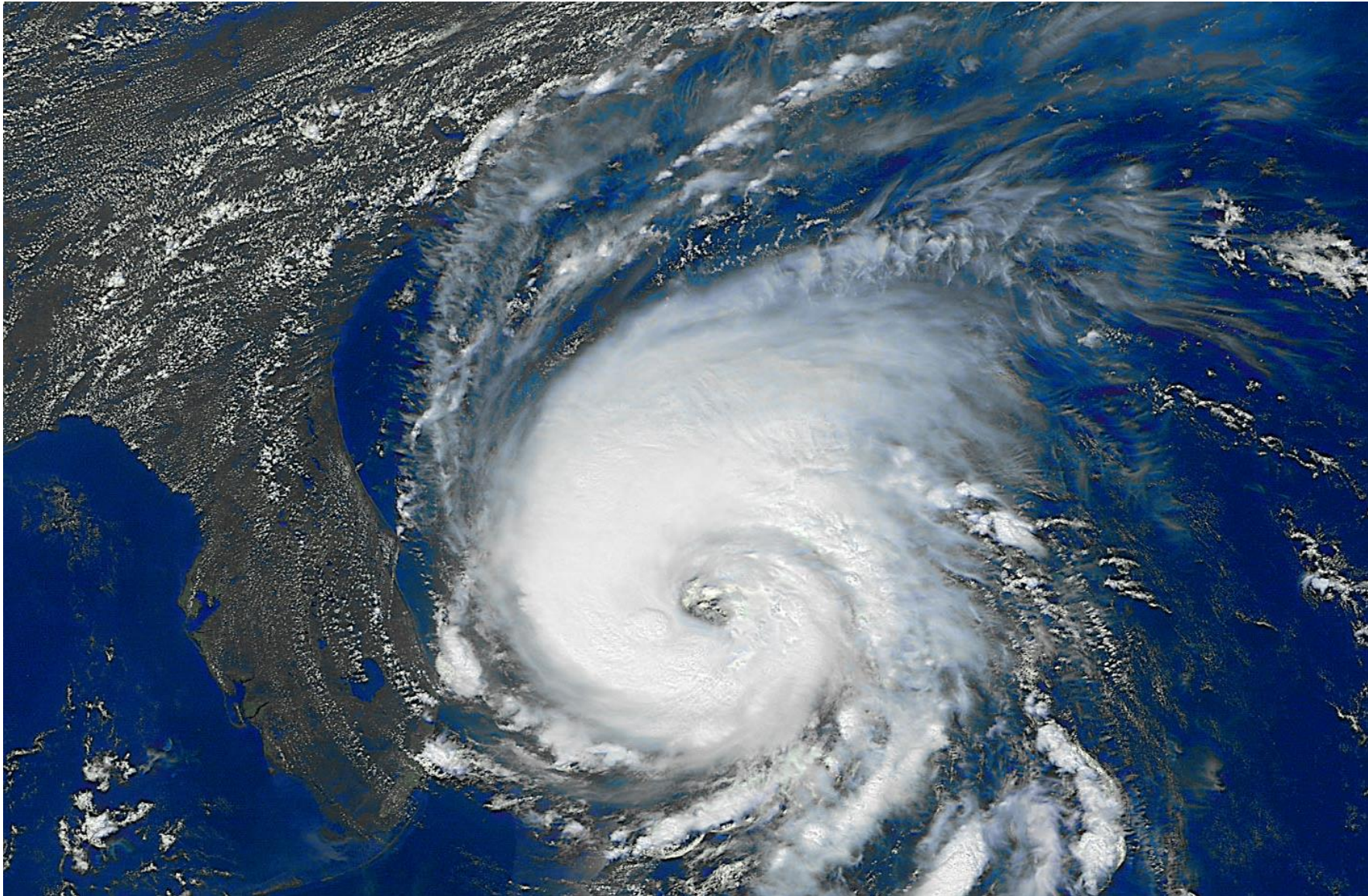


# Ongoing Resupply Operations





# Isolated and Not Easily Accessible

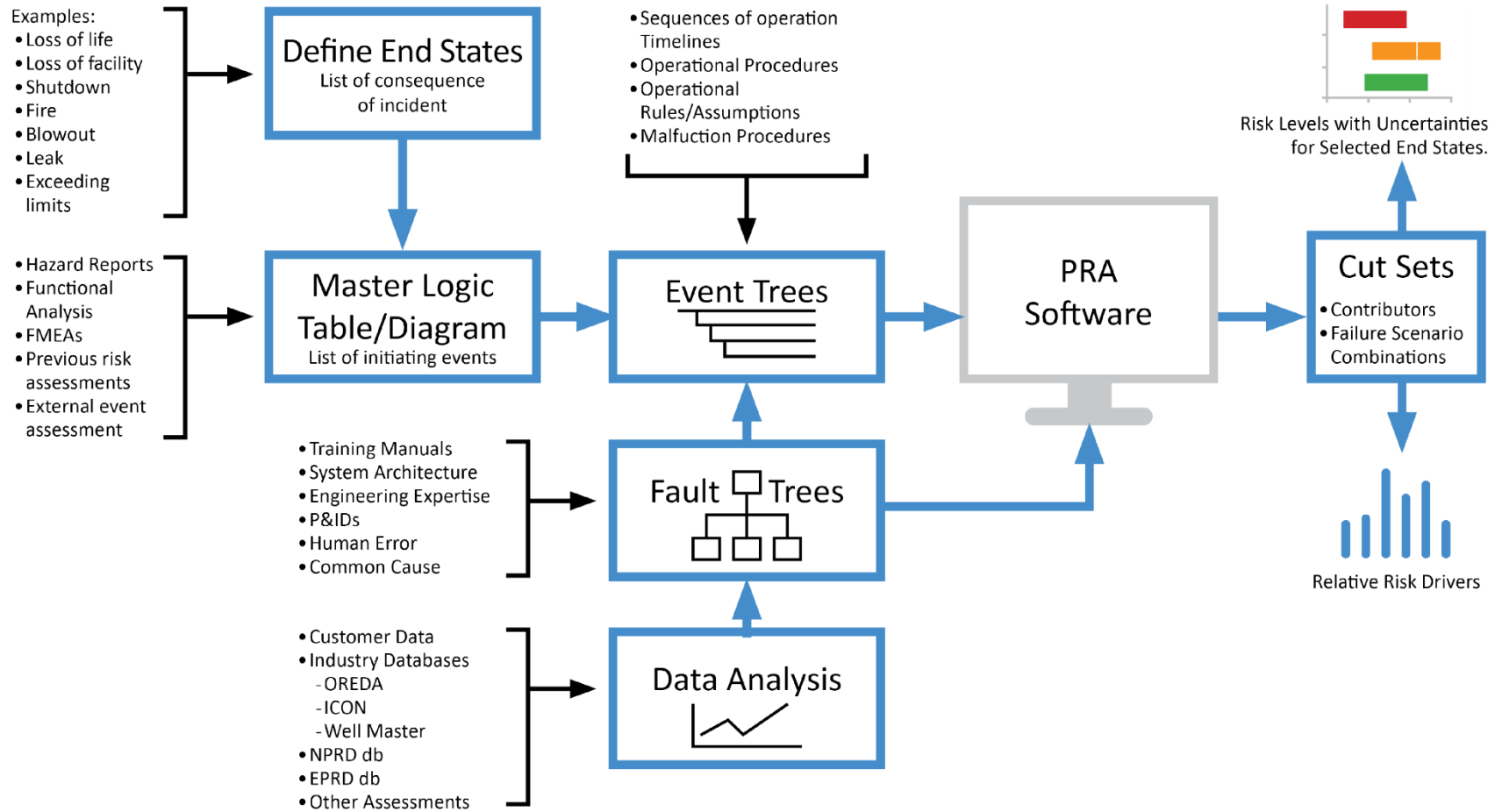




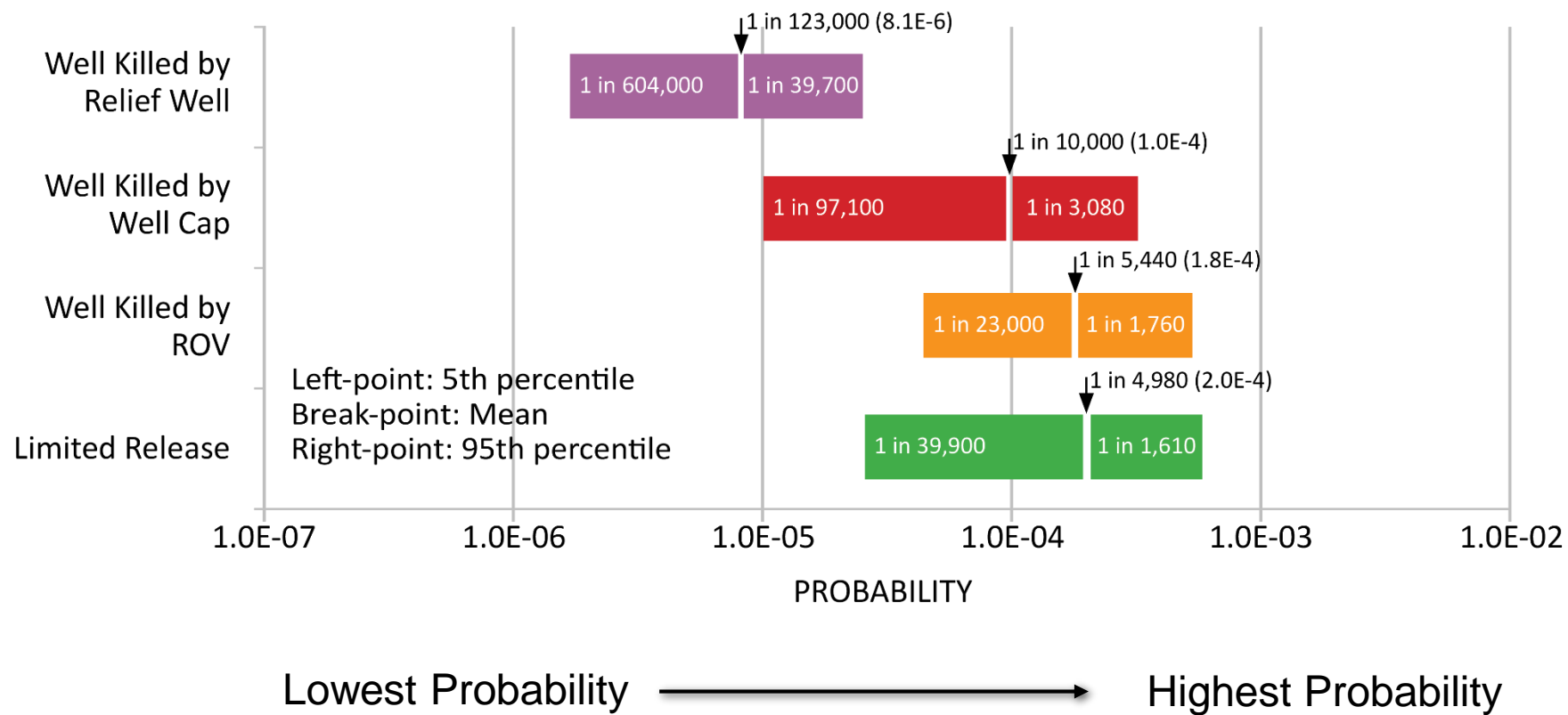
QUALITATIVE risk assessment is commonly based on experience or expertise and results in categorical estimates of risk.

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

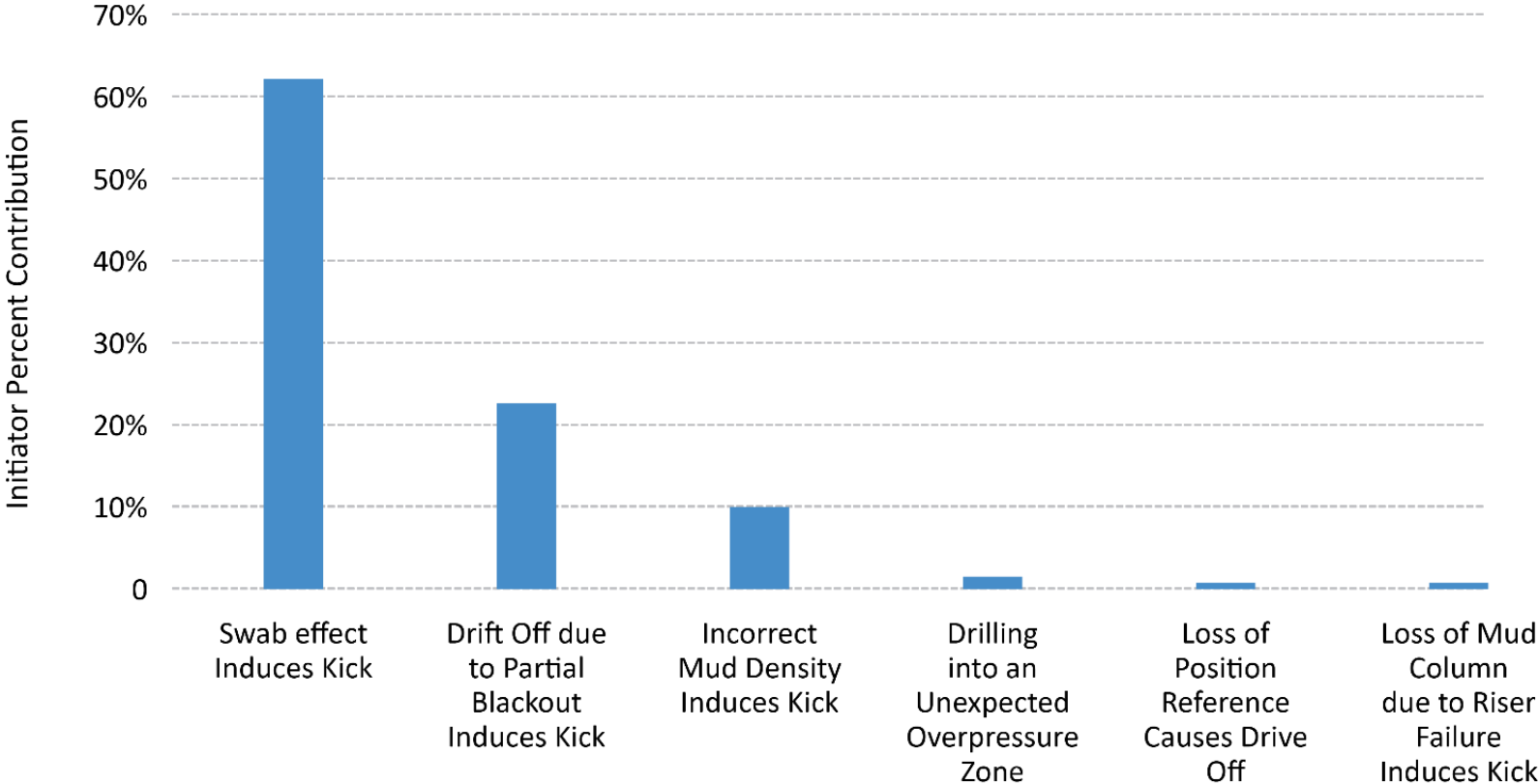
# Major Steps to Perform a PRA



# Notional Example of End State Probabilities with Uncertainty



# Notional Initiating Event Ranking Leading to a Well Kick



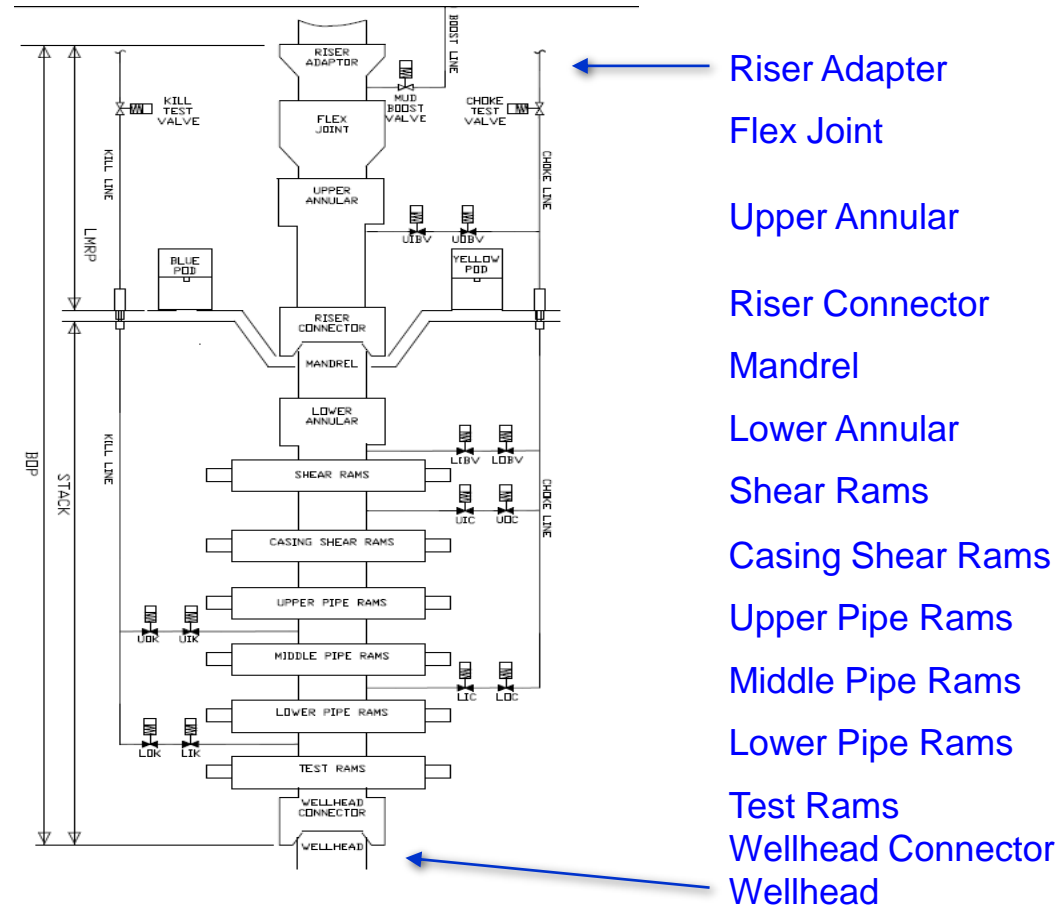
*Data in this figure does not represent any particular facility. Rankings may be different for slightly different designs or operational procedures/practices.*

# Generic 20,000 psi Blowout Preventer (BOP) Model



End State:  
Loss of Containment

- Initiating Events:
- Well Kick Occurs
  - Unplanned Disconnect Sequence is Required



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Expand the PRA Model to Include:

- BOP Surface Control Systems & Control System Sensors
- Emergency Disconnect Sequence
- Dead Man & Auto-Shear Sequences
- Hydraulic Lines and MUX Cables
- Mud System Sensors, Mud Logger Sensors; Driller Shack Sensors
- Tool Pusher Monitoring; Company Man Monitoring; Real Time Shore-Based Monitoring

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# Dynamic Positioning System (DPS) Model

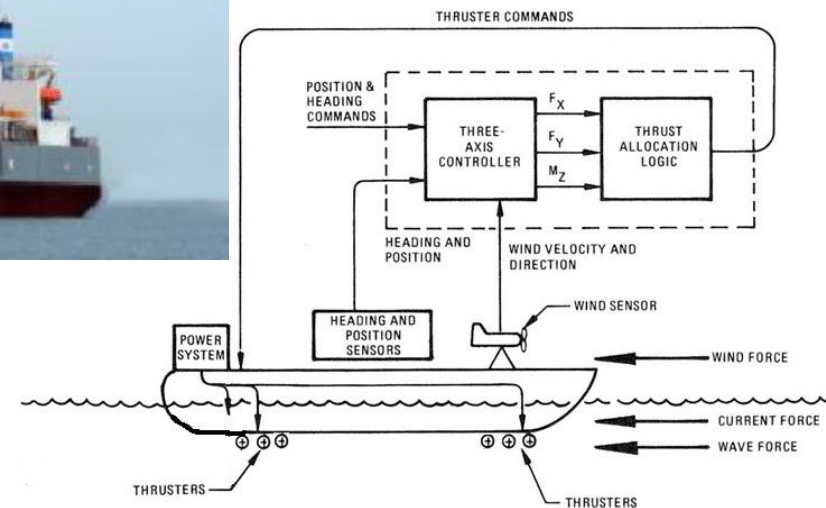


Class 3 Drilling Vessel

End State:  
Loss of Location

Initiating Events:

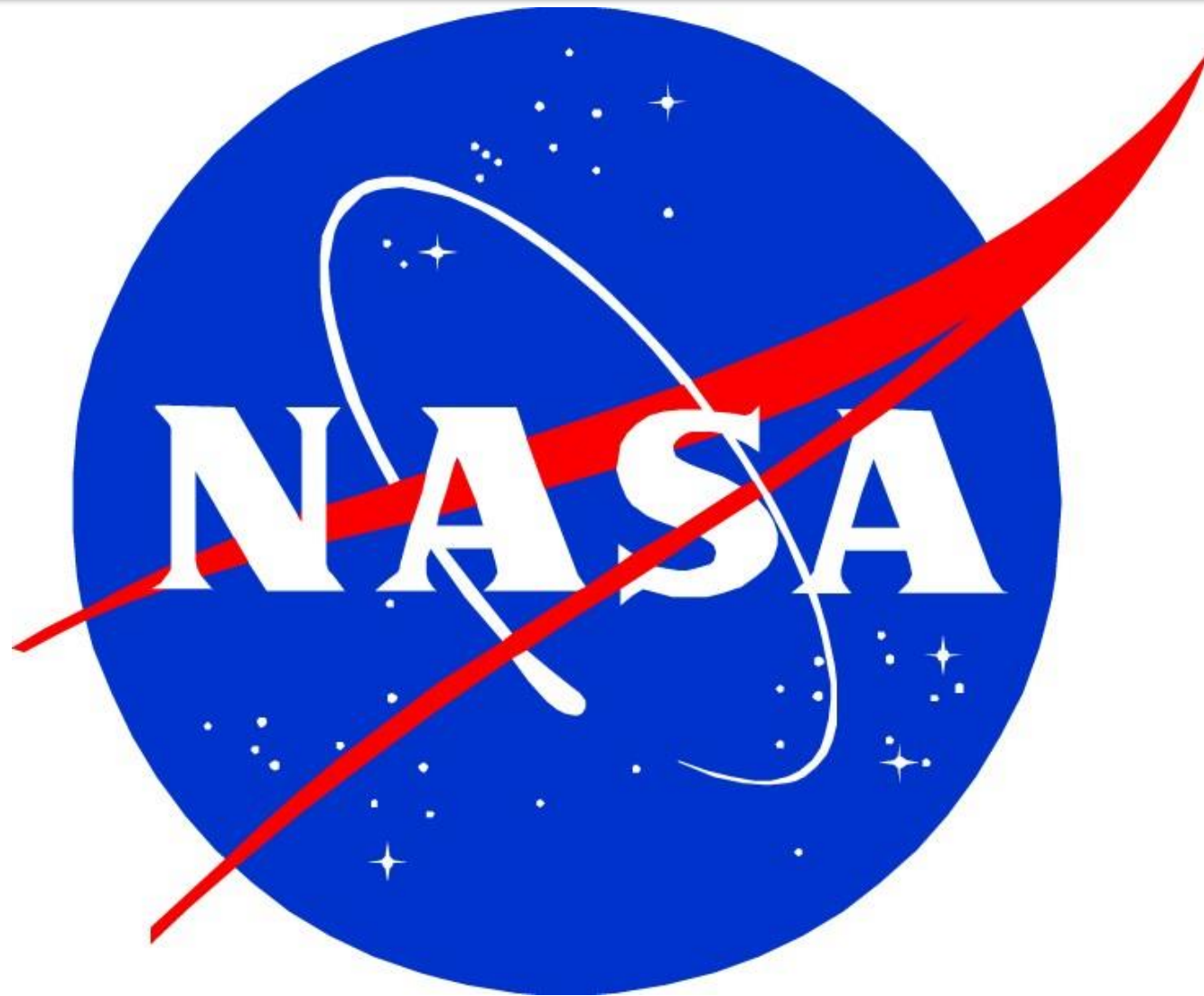
- Drift-off
- Drive-off
- Push-off



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**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.

# NASA – BSEE Interagency Agreement

The screenshot shows the BSEE website's newsroom page. At the top left is the BSEE logo (Bureau of Safety and Environmental Enforcement) and a navigation bar with links for 'Operating Status', 'Sitemap', 'Contact Us', 'Careers', and a search box. Below the navigation bar are menu items: 'About BSEE', 'Newsroom', 'Regulations & Guidance', 'Inspections & Enforcement', 'Exploration & Production', 'Technology & Research', and 'International & Interagency Collaboration'. The main content area is titled 'Home Page > BSEE Newsroom' and features a news article: 'BSEE, NASA Announce Agreement to Examine Risk Offshore'. The article is dated '03/17/2016 WASHINGTON' and includes a quote from BSEE Director Brian Salerno. A bulleted list of three primary objectives is provided, with the first objective mentioning NASA's probabilistic risk assessment technique and the third mentioning NASA's accredited failure analysis laboratory at the Johnson Space Center. A paragraph explains that NASA uses probabilistic risk assessment for space programs, and a final quote from Jack James at the Johnson Space Center concludes the article.

March 17, 2016

5 Year Agreement

NASA's probabilistic risk assessment technique

NASA's accredited failure analysis laboratory at the Johnson Space Center