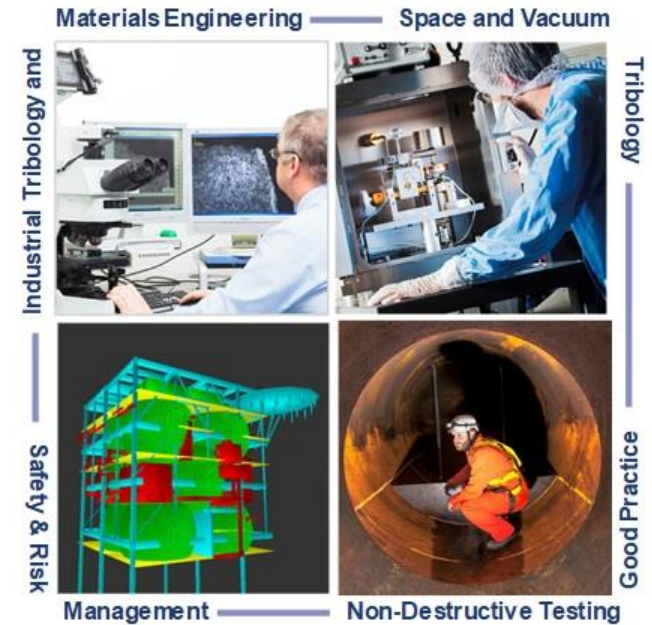


# Perspectives on Addressing Cumulative Risk

## Safety 30: Piper Alpha's Legacy: Securing a Safer Future

5-6th June 2018, AECC, Aberdeen

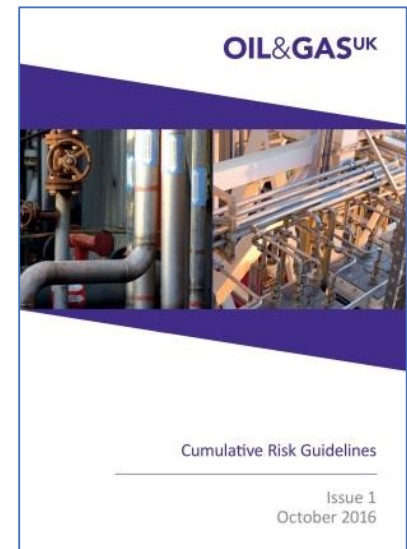
David Mansfield & Steve Forster



# What is Cumulative Risk?

## Oil & Gas UK Cumulative Risk Guidelines:

- “... in relation to major accident hazards (MAH). As part of their management, if an item of plant, a procedure, or a person is unable to function as effectively as intended, then this represents a deviation from the norm that needs to be managed. “
- “...There is a recognition that management of each deviation individually may not ensure that the cumulative risk of many deviations acting together is effectively managed.”
- “...Cumulative risk management covers the proactive management of multiple deviations and the risks from them including their interaction. Duty holders need to be able to demonstrate to themselves and the regulator how they manage cumulative risk.”



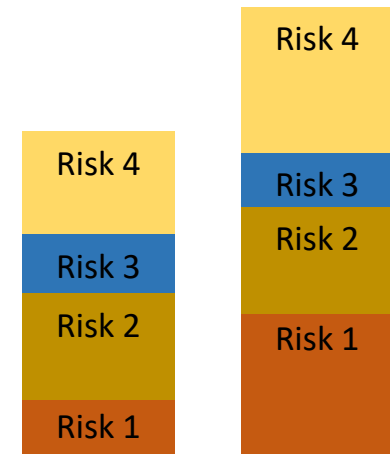
# Why Cumulative Risk?

**Initial concern was the impact on risk when several Safety & Env. Critical Elements (SECEs) are in a degraded state:**

- **Limitations of Operational Risk Assessments (ORAs):**
  - Single SECE status focus....
  - How effective at addressing multiple interdependencies that could increase the risks?
  - May not give overall picture?
- What about other risk factors that might add to the dependencies and affect the overall risks?

Adding  
Stand  
Alone  
Risks

With Inter-  
dependencies  
?



# Key Features of a Cumulative Risk Assessment



- Identify any degraded SECEs or other key Major Accident Hazard (MAH) features
  - Review and assessment of SECE status, and status of other risk related activities or conditions present on the installation
- Identify any interdependencies between these, and how they may affect other SECEs, etc.
  - Check how the degradation of one SECE or condition could impact other SECEs or conditions – to what extent could this further degrade the barriers?
- Consider the cumulative impact on the management of MAHs
  - How do the degradations and conditions identified impact the ability to manage the various MAHs – impact on Bow-Ties?
  - How might this affect the overall risks on the installation?
  - Are the risk management arrangements in place still adequate?
  - Are the risks still ALARP?

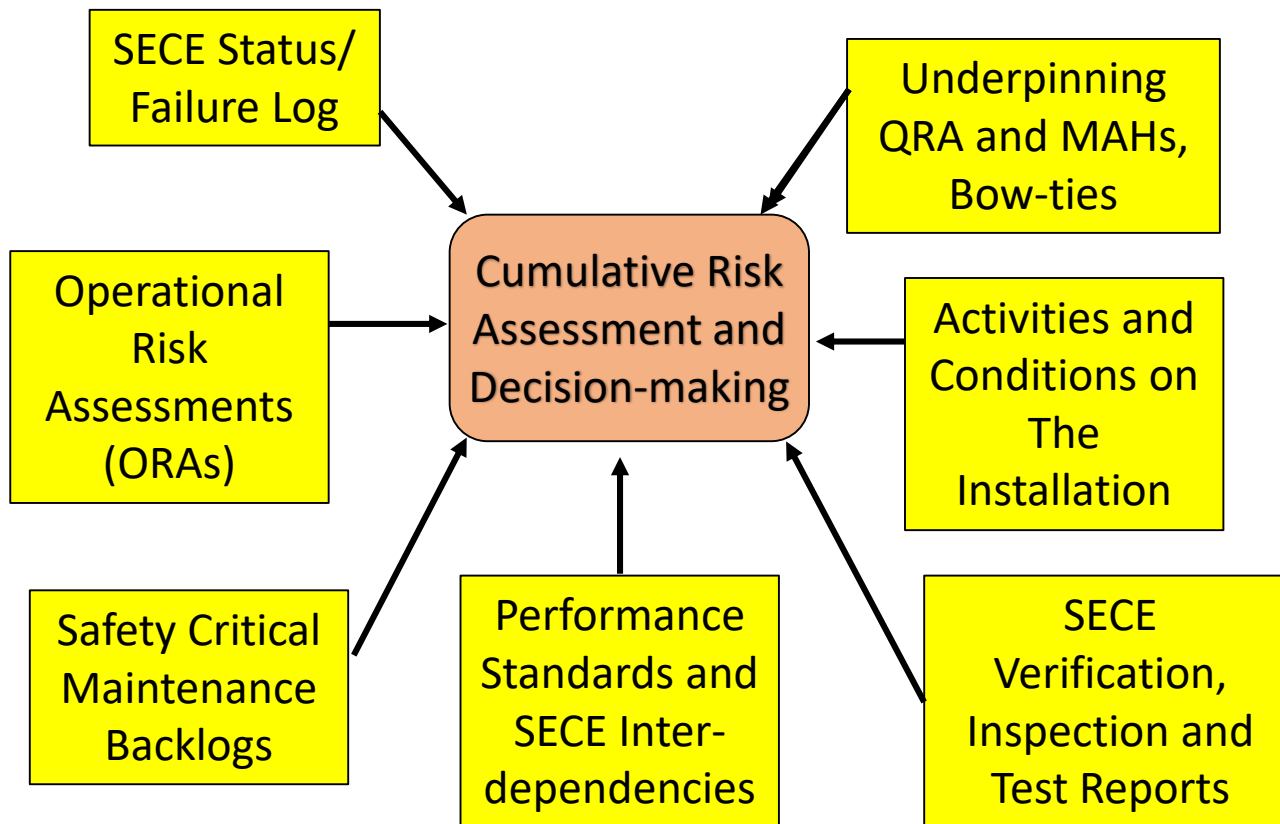
# Practical Approaches

1. Review of safety critical maintenance backlogs, ORAs and other asset integrity registers/ data
2. Status Assessment of all SECEs on an Installation – e.g. Status Dashboards
3. Bow-tie or “Swiss Cheese” Barrier presentation of SECEs status/ assessment to show impact on MAH hazard management
4. “Hot Spot” assessments taking account of the location of SECEs status and other conditions/ activities
5. A combination of these, also taking account of SECE interdependencies (e.g. via a dependency matrix)
6. Integrated SECE status, interdependency matrix, Bow-ties and other factors modelling to indicate risk change

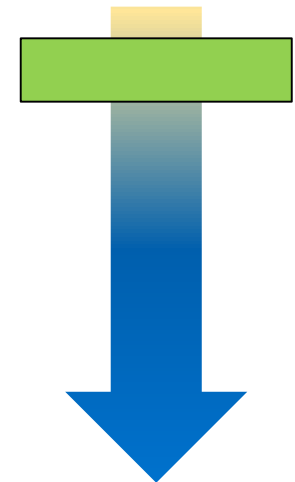
Increasing Level of  
sophistication in  
terms of  
Cumulative Risk



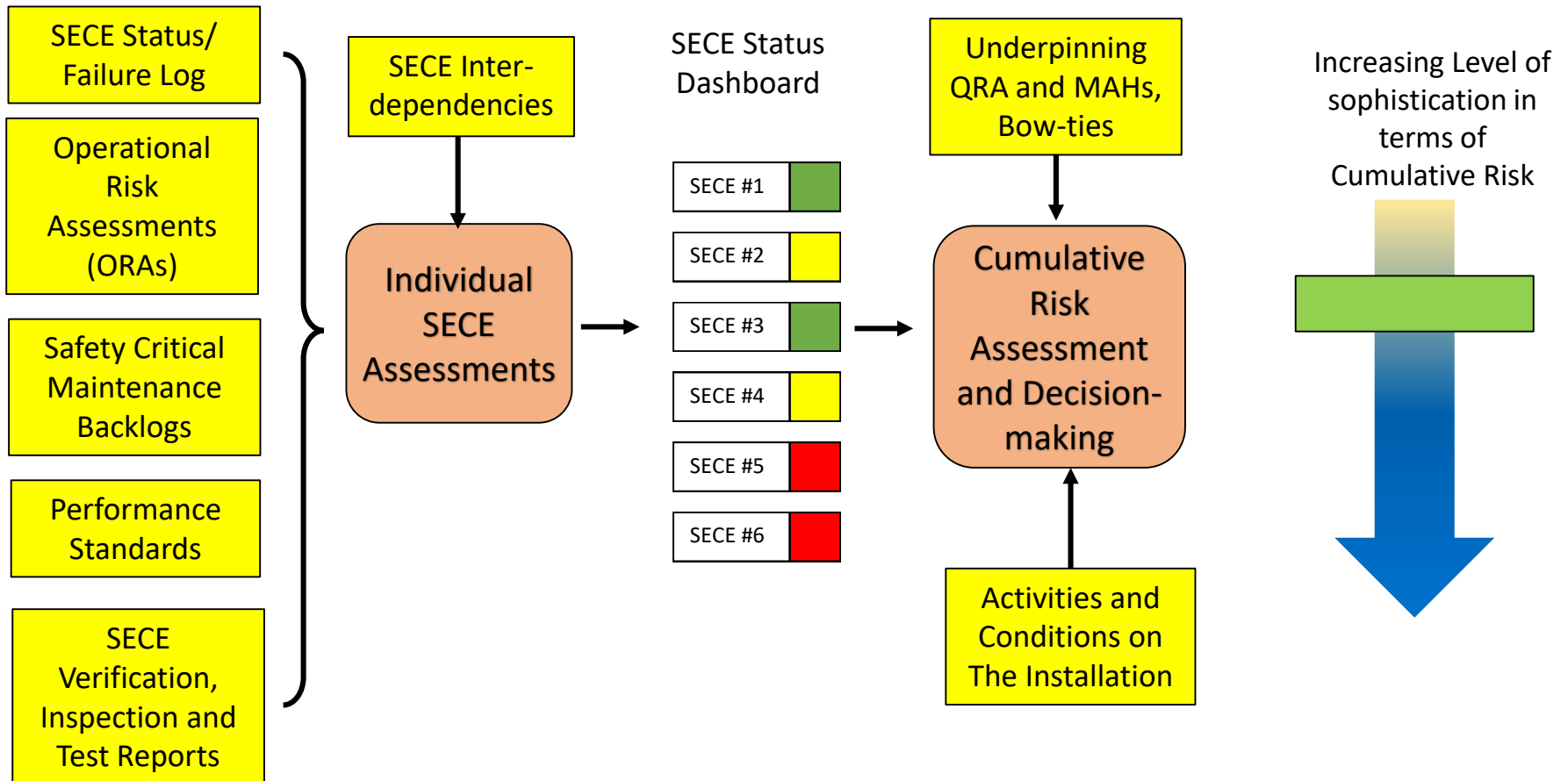
# Assessment Methods: Basic Information Review



Increasing Level  
of sophistication  
in terms of  
Cumulative Risk



# Assessment Methods: Overall SECE Status Analysis



# Basic Status Methods



- Review of safety critical maintenance backlogs, ORAs and other asset integrity registers/ data
- Status Assessment of all SECEs on an Installation – e.g. Status Dashboards

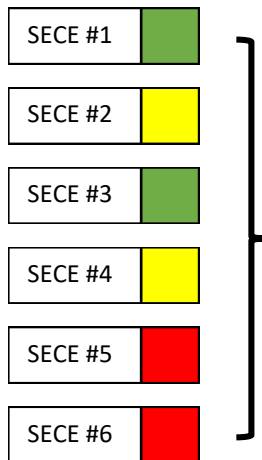
## Pros and Cons.....

- Provide overview of SECE status on an installation or across several installations
- Useful Process Safety Dashboard indicators
- Give overall impression of status of safeguards, but these:
  - May not take account of interdependencies between the SECEs
  - Don't show the overall impact on the management barriers for specific MAHs, hence: Cumulative risk can only be assessed by interpreting and augmenting the data

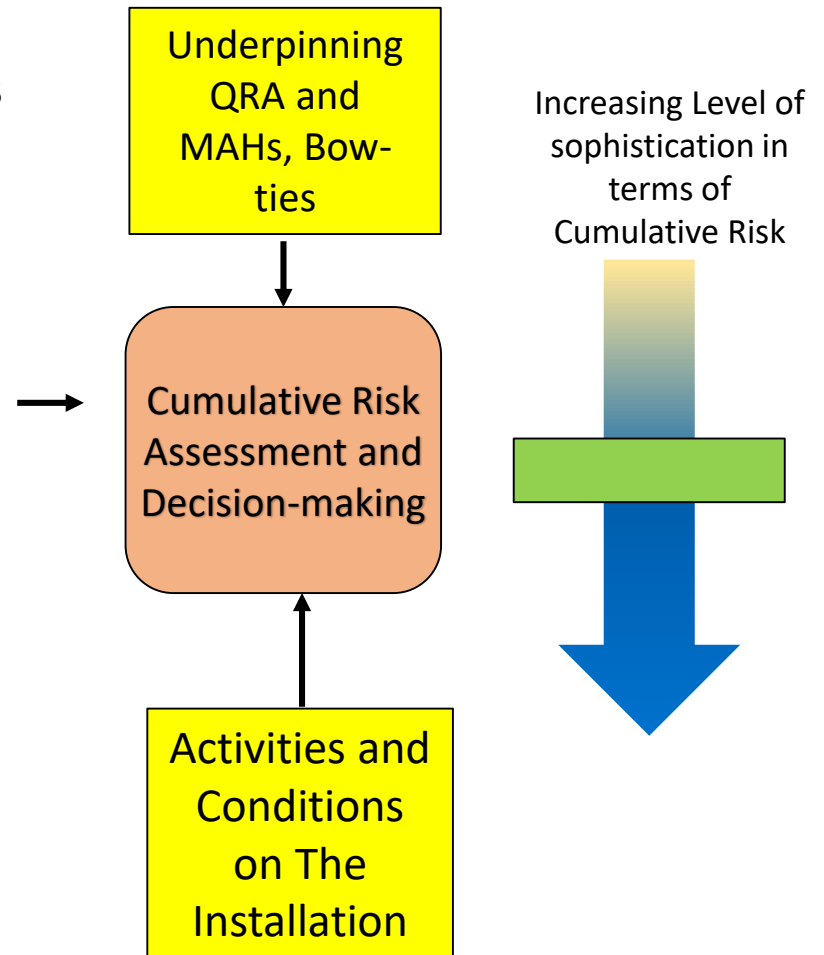
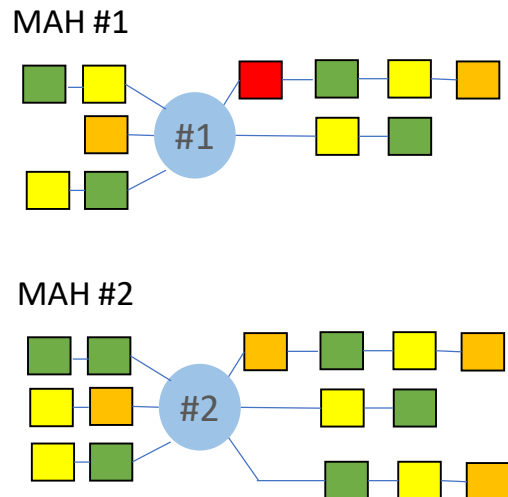


# Assessment Methods: MAH Bow-tie Impact Analysis

## SECE Status Dashboard

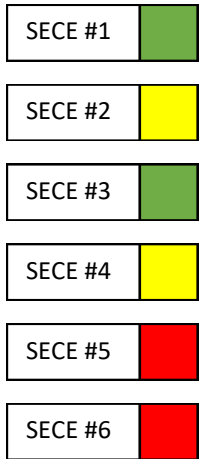


## Impact on MAH Bow-ties

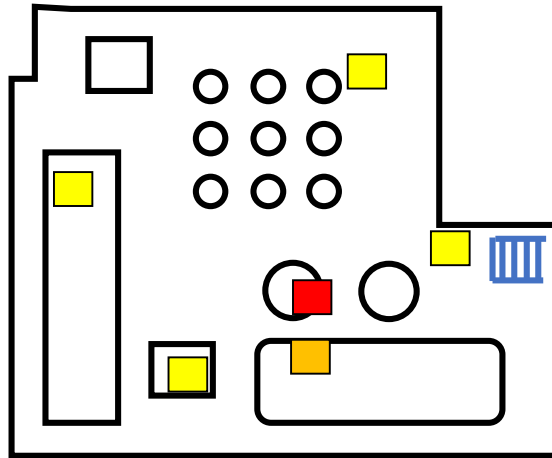


# Assessment Methods: Hot Spot Mapping of SECE Status

SECE Status  
Dashboard



SECE Status Location – Hot  
Spots Indication

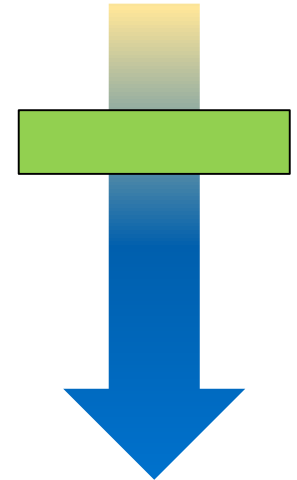


Underpinning  
QRA and  
MAHs, Bow-  
ties

Cumulative Risk  
Assessment and  
Decision-making

Activities and  
Conditions  
on The  
Installation

Increasing Level of  
sophistication in  
terms of  
Cumulative Risk



# Cumulative Methods



- Bow-tie or Swiss Cheese Barrier presentation of SECEs status/ assessment to show impact on MAH hazard management
- “Hot Spot” assessments taking account of the location of SECEs status and other conditions/ activities

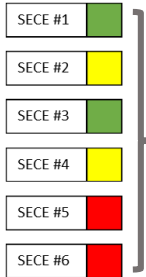
## Pros and Cons.....

- These alternative methods show two different windows on the risk profile – one based on the measures to manage each specific MAH, and the other based on location hot spots
- Each provides a means to identify the cumulative effects of various SECE degradations or issues with other conditions / activities
  - *Bow-tie / Barrier methods are useful as they focus attention on the MAHs*
  - *Location methods useful to identify “hot spots” – e.g. live status map on the installation to help with work planning*
- Using these two approaches in conjunction can be very informative!
- However, they may not take account of functional or system interdependencies between the SECEs
- Hence, still needs careful evaluation to interpret and augment the data

# Assessment Methods: MAH Risks Impact Analysis

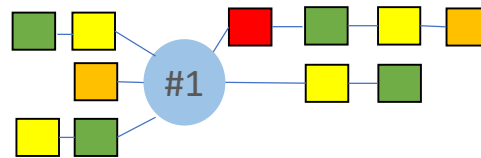
SECE Status  
Dashboard

SECE Inter-  
dependency  
Matrix

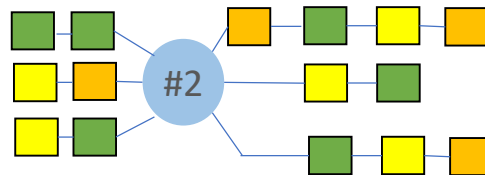


Impact on MAH Bow-ties

MAH #1



MAH #2

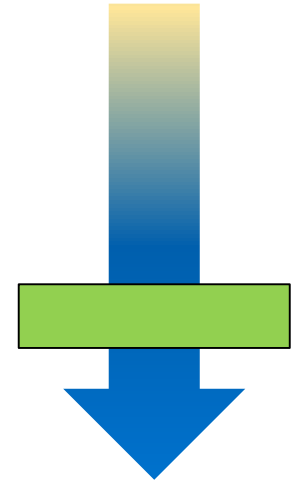


Risks propagated through  
MAH Bow-ties to indicate  
overall cumulative risks



Cumulative  
Risk  
Assessment  
and Decision-  
making

Increasing Level of  
sophistication in  
terms of  
Cumulative Risk



Underpinning  
QRA - MAH  
Risks for each  
Bow-tie

Risk Impact of  
Activities and  
Conditions on  
The Installation

# Integrated Methods



- A combination of methods, also taking account of SECE interdependencies (e.g. via a dependency matrix)
- Integrated SECE status, interdependency matrix and other factors modelling to indicate risk change

## Pros and Cons.....

- Combining MAH Bow-Tie/ Barrier assessment with a SECE interdependency matrix provides a good basis to assess the cumulative risk for SECE degradation
- Enhancing this by using QRA data on the MAHs to weight the Bow-tie degradation provides a means to turn the static QRA in to a “living QRA”, and make it more useful to the offshore and onshore teams
- Use of a mathematical model to underpin the assessment also allows other factors or conditions to be included
- Ability to show key risk drivers (i.e. risk contributions for the various degradations/ deviations) and help users assign priorities for remedial actions

# Practical Considerations

- Frequency of Cumulative Risk Assessments?
  - weekly-monthly? – things can change quickly!
- Ability to “horizon scan”?
  - how will things change next week?
  - if we reschedule work, how will this affect the risks?
- The human factor...
  - Whatever method used – interpreting the information and decision-making is key, so the people involved really do matter
  - The method needs to be manageable in terms of data inputs, frequency of assessment, time required, etc. (Granularity/detail vs time)
  - Aim should be to drive behaviors so that the risks are better understood and better managed by management, technical authorities and those at the ‘coal face’ i.e. improve understanding and decision making



# Feedback from Users



- Input should:
  - Be kept to a manageable task - <30 minutes
  - Allow access for several users to input data e.g. Operations, Technicians, TAs, etc.
  - Have the ability to take account of SECE deferrals and consider different levels of mitigation in ORAs
  - Use a team approach to the assessment to agree action priorities and check risks still ALARP/ tolerable

# Feedback from Users



- Output should:
  - Have a simple visual presentation of outputs  
e.g. traffic lights, “live” bow-ties
  - Visually present any ‘active’ interdependencies
  - Have the ability to drill down the causes  
e.g. show cumulative risk contributions against each input/deviation
  - Record the assessment. Important, as it enables targeted discussions with others and provides record of the decision basis



# Feedback from Users



- Cumulative Risk Decision support tools have allowed:
  - More relevant discussions both offshore and onshore around MAH and risk, and the influence of different risk drivers and relationships
  - Conversations and decisions to be escalated from offshore to onshore in line with increasing risk output levels
  - Metrics to be tracked in a process safety dashboard at leadership level
  - Focus on timeframe to resolution of impairments, and as such challenges on remedial actions
  - Looking ahead and what-if views of future installation status e.g. shutdown scope conflicts and restart post shutdown.

# Looking to the Future...



- Increasing desire for web-based information sharing
  - Central access points for all users, with appropriate access controls
  - Ability to present the information and results in different ways to best suit the type of user (TAs, Senior Management, Offshore Teams, HSE Team)
  - Ease of data storage and analysis for archiving, trending, dashboards, KPIs, etc.
- Data mining to automate data gathering
  - Automatic feed of data from Maintenance Management System, Asset Registers, Activity Logs / PTW into cumulative risk assessment

## But...

- Important for the users to retain 'ownership' of the assessment process
- If people do not feel involved in the assessment, then their understanding of the situation and its causes, and the quality of decision-making will decline

# Thanks, any Questions?

