MARSH

LEADERSHIP, KNOWLEDGE, SOLUTIONS...WORLDWIDE.

Risk Engineering and Renewable Energy

Karachi Insurance Institute Seminar

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Dubai

MARSH & McLENNAN COMPANIES

Agenda

- Introduce the Marsh Global Risk Engineering Team
- Tailoring conventional energy risk engineering to renewable needs
- Risk engineering renewable energy construction projects
- Focus on Terrorism and Political Violence

Marsh Global Risk Engineering

Marsh Global Power and Energy Risk Engineering

Marsh Global Risk Engineering Model

- Regional Hubs
  - Expertise matching the client requirements
  - Engineers local to client sites and Corporate staff
- Hubs supported by London “Technical Centre of Excellence”
  - Smooth out resource demands
  - Speciality Practice for Business Interruption
  - Technical Methods and Standards Ownership
    - Although often significant expertise in the Hubs
- Expanding Power expertise in the Dubai Hub

Global Renewables Experience

Tailoring Conventional Energy Risk Engineering to Renewable Energy Needs

Operational Risk Exposures - Comparison

Conventional Energy

- Inherent fire risk (fuel or feedstock)
- Explosion
- Toxic
- Natural catastrophe
- Machinery breakdown
- General fire
- Electrical
- Terrorism and Political Violence
- Marine
- Third party

Renewable Energy

Construction Risk Exposures - Comparison

Conventional Energy

- Inherent fire risk (fuel or feedstock)
- Explosion
- Toxic
- Natural catastrophe
- Machinery Breakdown
- General fire
- Electrical

Renewable Energy

- Civils can be a larger portion of the risk
- Business Income

Bespoke Survey Approach for Renewables

- Lack of inherent fire and explosion hazards leads to fewer EML scenarios
- Size of facilities is generally smaller
- Value of facilities generally lower
- Organizations are generally smaller
- Lower staff density at facilities
- Surveys are generally shorter
- Higher focus on specific features
  - Structural and Civil
  - Electrical
  - Machinery Breakdown

Consistent Qualitative Approach

- Marsh recognise bespoke needs of Renewable Energy Projects
- Have developed technical methods
- Risk Ranking allows objective approach to risk quality

TM.205

Marsh
Global Energy Risk Engineering

TM.205

Technical Method for:

Risk Ranking of Offshore Windfarms

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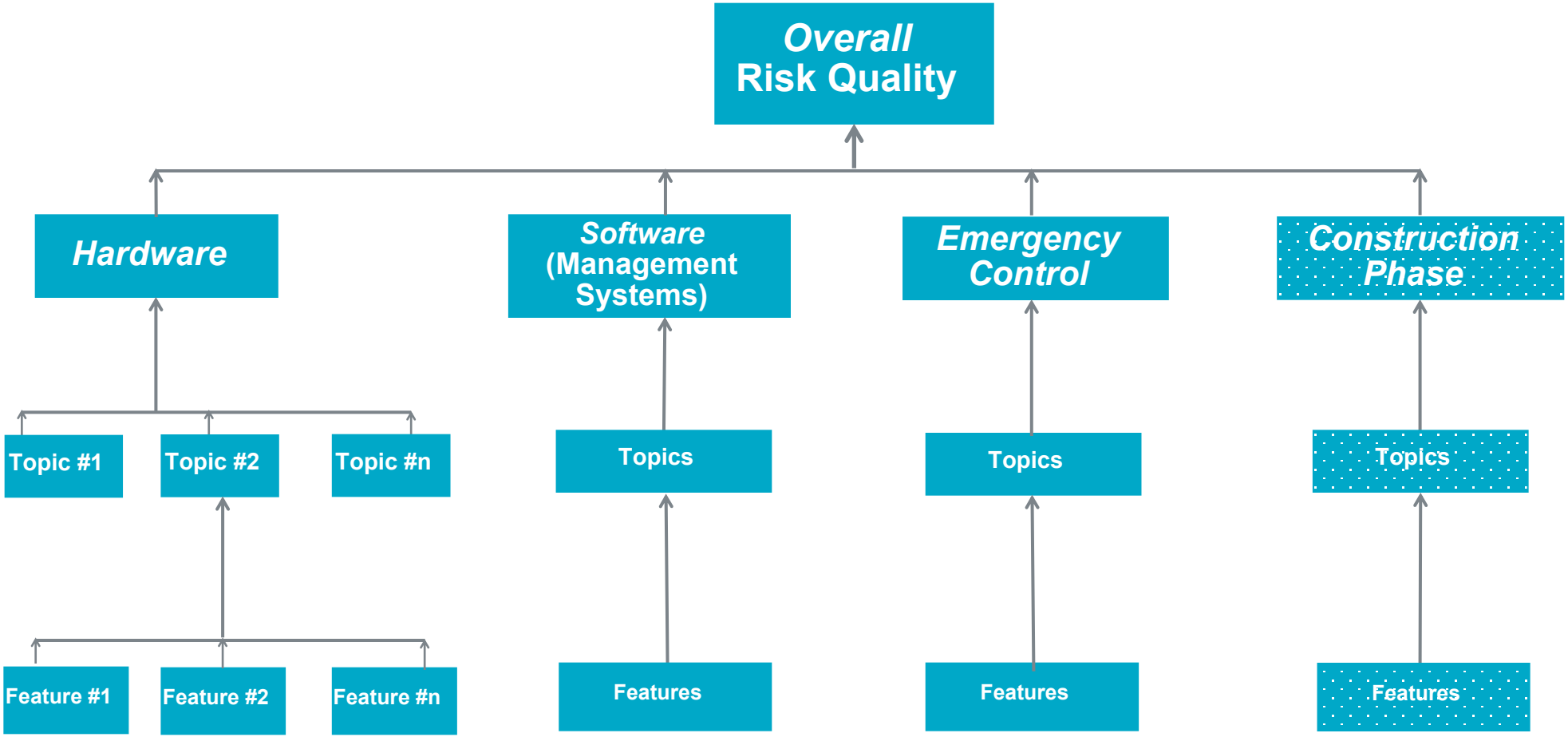
Marsh Global Energy Risk Engineering

TM.339

Technical Method for:
New Project Reviews of Offshore Wind Farms

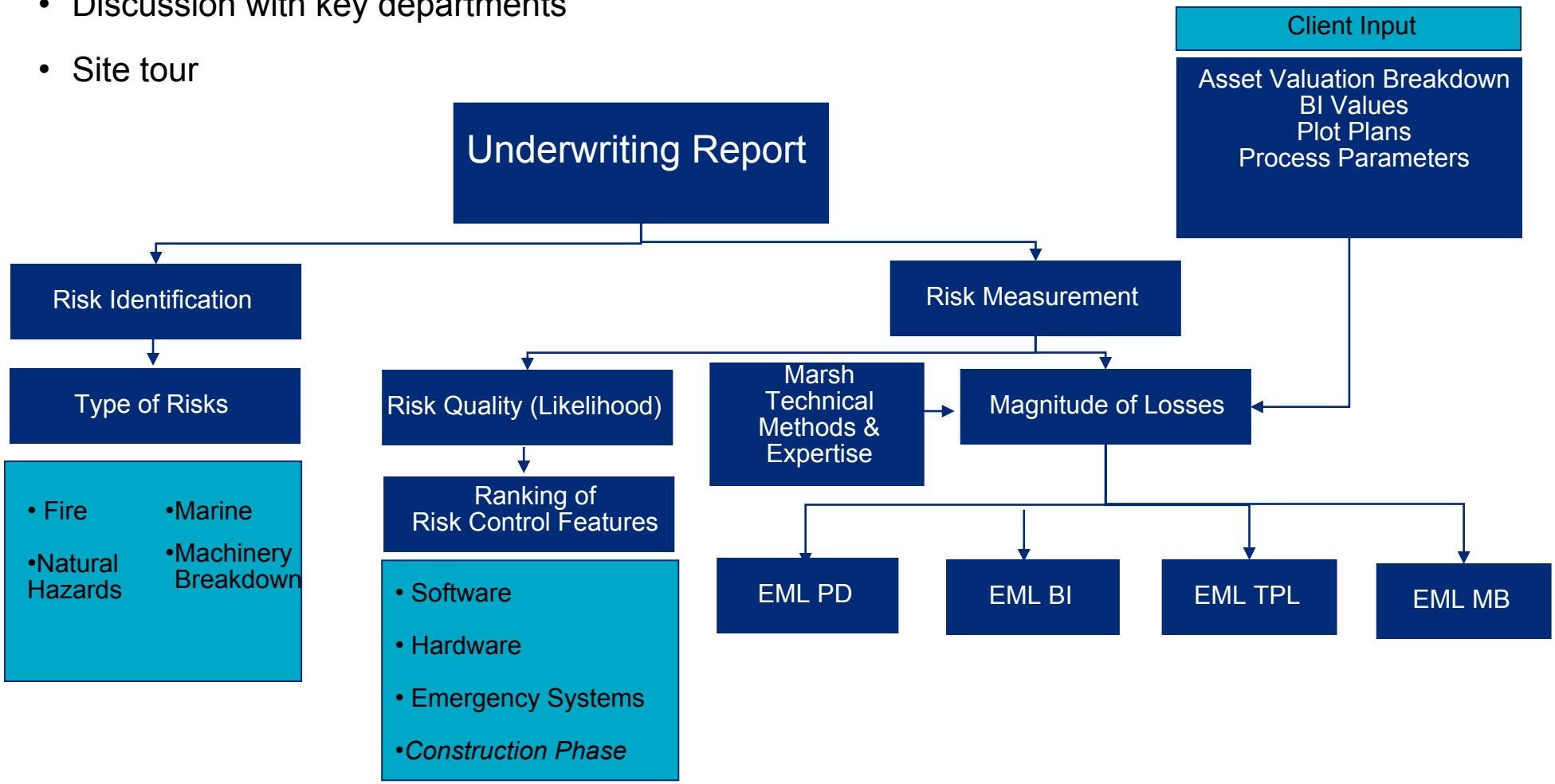
Risk Ranking – Determining the Insurance Quality of a 'Risk'



- All weighted according to priority, based on engineering opinion and feedback from the insurance market

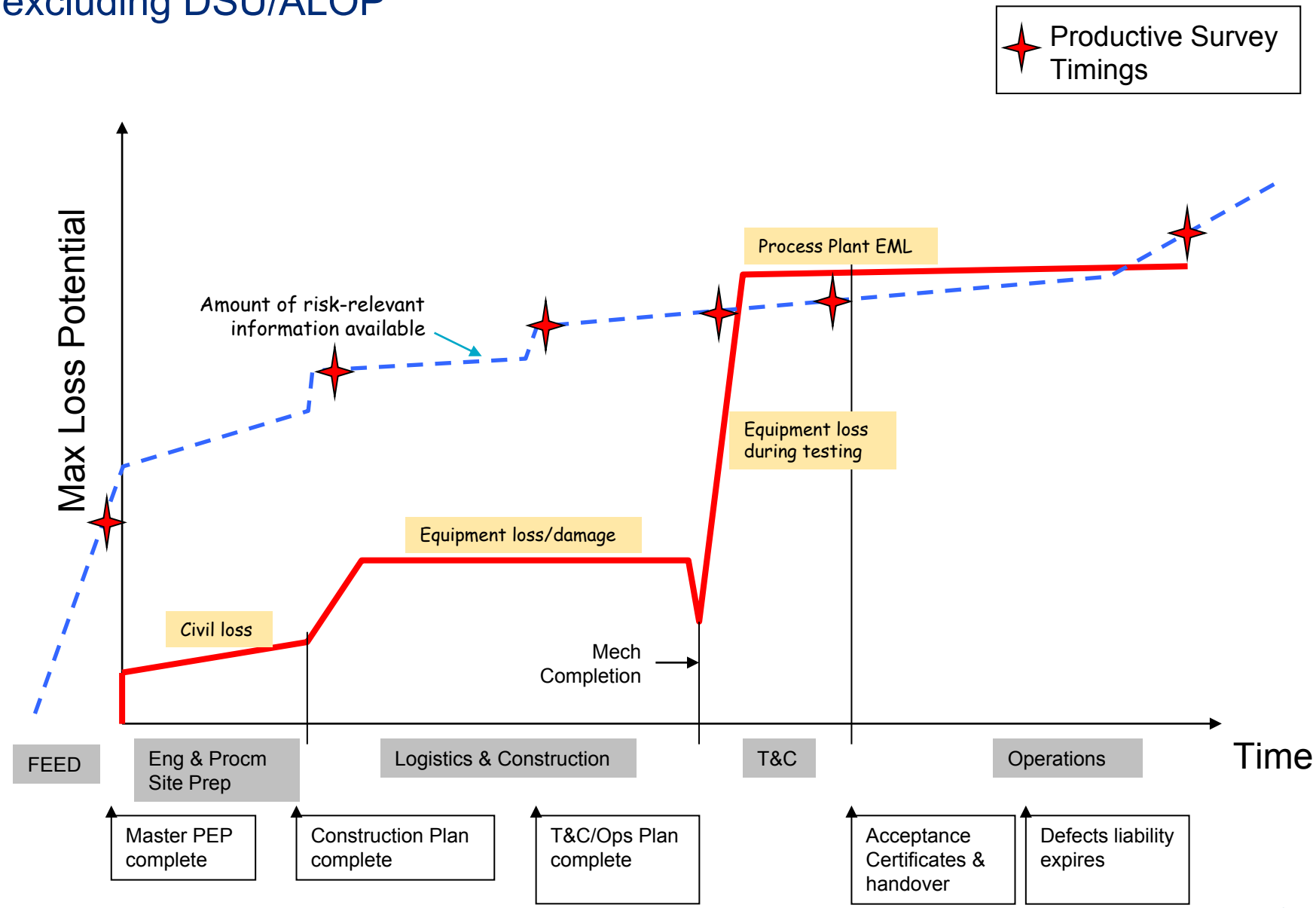
Engineering Survey: Preparation of a Underwriting Report

- "List of Information Required" in advance of survey
- Discussion with key departments
- Site tour

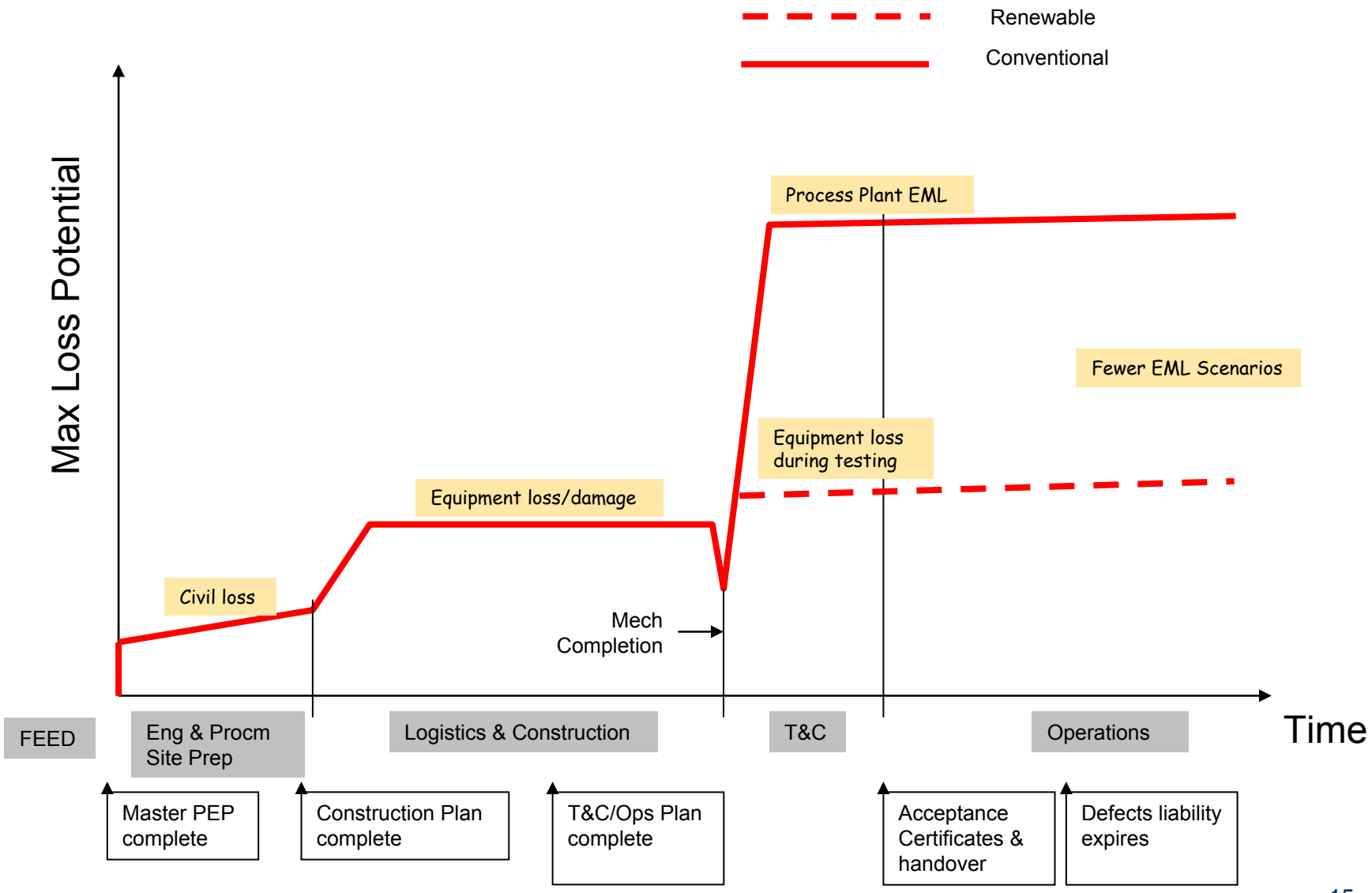


Risk Engineering Renewable Energy Construction Projects

Typical Conventional Energy or Power Construction Risk/Loss Profile …..excluding DSU/ALOP



Typical Renewable Energy Construction Risk/Loss Profile …..excluding DSU/ALOP



Advantages of Early Engagement

- Risk Engineering is best conducted consistently across a project life-cycle
  - Feed/Design…….*Where early broker engagement*
  - Construction
  - Testing & Commissioning
  - Operations

- Marsh bring the early engagement of Risk Engineering issues
  - With lenders and their advisors
  - Client engineering team expecting to provide information, perhaps deal with some recommendations, need for site surveys already established
  - Additional information often obtained – anticipating market needs

Operational Risk Improvement Recommendations

- Fire Detection/Protection
  - Often remote locations with slow response time
  - Transformers and substations
- Flood Protection
- Transformer Maintenance/IR Scanning
- Root Cause Analysis for Critical Equipment Losses
- Business Continuity Plans

- All can be addressed more cost effectively before the assets are built!

Example of Actual Recommendation

SOLAR FARM FLOOD PROTECTION	CATEGORY A	REC #
DATE RAISED/REV		
RISK EXPOSURE	**Flooding**	
DESCRIPTION	Flood modelling indicates a possibility of site flooding from the local river. No flood protection is currently in place.	
RECOMMENDATION	***Implement flood protection on site, the following are potential options:*** ***Option 1***: Build-up an embankment, minimum 1.2 m height, on the north and on the west side of the plant, outside the plant perimeter. ***Option 2:*** Build-up a concrete wall, minimum 1.2 m height, within the plant area next to the fence, to protect the plant from flood. This would have to be a substantial construction with deep below ground foundations – min. 0.60 – 0.8-m deep. ***Option 3:*** Build-up a system of drainage channels on the west, north and east side and connect them to the existing drainage channel on the south side of the plant site – in that case water can flow around to the plant site without any damages on the property.	
CLIENT RESPONSE		
STATUS		

EML Exposures

- Natural catastrophe

- Fire
- Machinery Breakdown

- Terrorism and Political Violence

Terrorism and Political Violence Insurance

- Requirement to purchase cover for potential losses due to terrorism activities ‘becoming’ commonplace in energy sector
  - Lender’s requirement
  - ‘Perceived’ nature of operating region
  - Legacy issues
  - Regulatory requirement
- Cover typically requested for full asset value
  - Plausible for Property sector
  - Pragmatic for Energy installations which are spread out?
- Require a more, transparent, consistent, knowledge-based approach which supports Clients, Underwriters and Lenders

The Process

DETERMINE SITE'S VULNERABILITY TO AN ATTACK

↓

ASSESS THE SITE AGAINST A SET OF CONSISTENT FEATURES

↓

ESTABLISH POTENTIAL LOSS SCENARIOS

↓

DERIVE A $$ NUMBER AS A RESULT OF THE MAXIMUM LOSS

Assessing Vulnerability
Target Selection

- Key question to consider - ***'What is the aim of the terrorist?'***

Can be challenging to answer these questions, at times impossible, HOWEVER, there is available data to offer a knowledge-based opinion which can help Clients, Lenders and Underwriters better understand the risk they are dealing with

- What is the philosophy / motivation of existing groups in attacking this site?
- How likely is it that they understand the value of what they are attacking?
- What are the chances of them picking this site above all others?

RISK APRAISAL
VULNERABILITY FACTOR

- Information gathering via a site visit and various other sources
- Determination of the site's ***'Vulnerability Factor'***
- Defined as;

RELATIVE VULNERABILITY OF AN INSTALLATION TO SUCCUMB TO AN ATTACK

- Site is critiqued using a set of Features, which are individually 'weighted' which influence the probability of successful attack
- Consistent, Marsh-engineer-transferable process, similar to that done on UW surveys and the Risk Ranking methodology of Categories, Topics and Features
- Relative 'weighting' a product of peer reviews, technical assessments and consultation with external parties, e.g. think-tanks and intelligence agencies

RISK APRAISAL
VULNERABILITY FACTOR

- Vulnerability features (each with associated weighting):
  - Country Risk (Maplecroft ™ TRI)
  - Corporate Identifiability
  - Site Identifiability
  - Accessibility
  - Security Force Response Capability
  - Achievability
  - Target Hardness
- Opportunity to fine-tune weighting in collaboration with the Insurance market

RISK APRAISAL
SEMI QUANTITATIVE PROBABILITY ASSESSMENT

- By allocating a score against the defined ‘weight’ a ‘Site Achieved Score’ is produced:

SCORE	VULNERABILITY
0 - 15	Critical
15.1 - 40	High
40.1 - 70	Significant
70.1 - 100	Modest
100.1 - 115	Low
115.1 - 121.2	Minimal

LOSS SCENARIOS
OVERALL APPROACH

- Three scenarios to evaluate PD EML at the site
  - A bag bomb carried into plant, placed at highest value asset
  - A car bomb driven onto plant, parked alongside road
  - A truck bomb detonated at site entrance
- Payload sizes aligned to vehicle / transport capabilities and expert opinion*
- Most probable explosive type identified, along with TNT equivalent based on density and explosion force potential
  - E.g. 1 kg TNT = 0.6 kg Semtex = 0.75 kg C-4

* National Terrorism Centre (USA) & Central Intelligence Agency (CIA)

LOSS SCENARIOS
OVERALL APPROACH

- Independently assess Business Interruption potential
  - Might not be associated with the largest PD EML
- Exclusions
  - Will not attempt to model Chemical-Biological-Radioactive-Nuclear (CBRN) weapon attacks
  - Does not currently account for multiple synchronous attacks
    - This has been the hallmark of Al-Qaeda attacks, but too difficult to 'predict'

DERIVATION OF A MONETARY VALUE
LOSS MODELLING

- Explosion Modelling
  - SLAM; using either TNT or Ethylene Oxide equivalent
  - Consequential impacts

Conclusion

- Marsh Global Risk Engineering Team is local to the needs of clients, underwriters and lenders in Pakistan
- Many renewable energy risk exposures are similar to conventional energy
  - Although a bespoke approach is required
- Risk Engineering can add value throughout a construction project lifecycle
- When considering Terrorism and Political Violence, Marsh Technical Methods allow a more, transparent, consistent and knowledge-based approach
  - Supports Clients, Underwriters and Lenders

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THANK YOU

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This may be viewed on our website http://www.marsh.co.uk/aboutMarsh/principles.html

VULNERABILITY FACTOR
SEMI QUANTITATIVE PROBABILITY ASSESSMENT

FEATURE	DESCRIPTION	SCORING	WEIGHT
Accessibility	g the loca and acc sing a tar inside the site (considers PASSIVE security features only)	3 = Feature 1, feature 2, feature 3, feature 4, feature 5, feature 6 = Feature 1, feature 2, feature 3, feature 4, feature 5, feature 6, feature 7	3

Probability that th successful in re location and acces inside the site (PASSIVE security

3 = Perimeter fence >3.0 m; barbed wire topped; chain link fence with intruder detection system; fence is separated from public road by ditch/dyke and tree belt; full perimeter lighting; >70% coverage by cameras; remote access gates locking mechanism is not accessible to personnel outside the fence; remote access gates blocked off from public road (i.e. concrete blocks); additional internal fence surrounding Process & Offsites areas

ACCESSIBILITY

ATTACK SCENARIOS, DEVICES AND DEPLOYMENT
BAG BOMB

- 25 kg TNT-equivalent bomb placed in carry-on bag exploded on highest value unit on site
- Scenario has some precedence (Iraq, Baiji Refinery), albeit not covert
- Plastic explosives used
  - (C-4 / Composition B / Semtex)
  - 15-18 kg, highly portable
- Transported in a briefcase, hold-all or sports bag by an average strength person
- Looks at a bomb detonating in the control room but will depend on Marsh's site assessment to identify barriers

ATTACK SCENARIOS, DEVICES AND DEPLOYMENT
CAR BOMB

- 450 kg TNT-equivalent car bomb exploded on a paved road adjacent to the highest value ‘accessible’ unit
- Frequently used terrorist weapon (PIRA, ETA, Al-Qaeda,)
- Utilises Ammonium Nitrate-Fuel Oil (ANFO) mixture – easy to obtain/assemble
- Actual quantity is 560 kg (max payload for a large family vehicle)
- Unit deemed inaccessible to attackers, therefore placed on road alongside

ATTACK SCENARIOS, DEVICES AND DEPLOYMENT
TRUCK BOMB

- 4,500 kg TNT-equivalent truck bomb exploded at paved road outside the site fence as close as practicably possible to highest value unit
- Engineer might consider within site fence based on site's road logistic arrangements
- 5,600 kg ANFO, max payload for a average-sized, rigid-body delivery truck
- Very few examples of a larger bomb successfully detonated (Khobar, 9.1 tonnes)