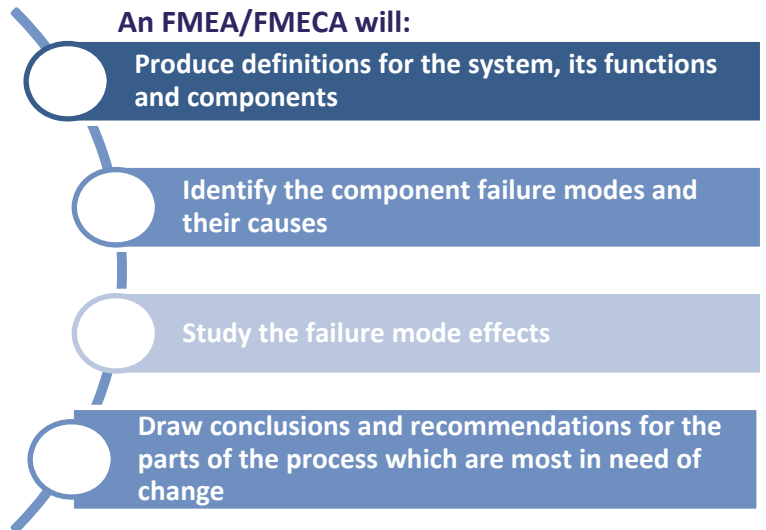




What is it?

Failure Modes and Effects Analysis (FMEA) is a systematic method for evaluating processes and components for potential failures. The effects of each component failure mode are analysed and the failure modes significantly affecting the reliability, availability, maintainability or safety of a system are identified.

Failure Modes, Effects and Criticality Analysis (FMECA) is a natural extension of FMEA in which the occurrence probability and the criticality level of each failure mode is assessed.



Why is it important?

FMEA/FMECA can be performed at various stages of the design, manufacture or operation of components. FMECA will highlight areas of weakness in the design of a component by providing an



inventory of the failure modes according to their frequency and the extent of their relative impacts on the system functions. FMEA/FMECA will suggest potential design improvements; for example to modify the means of detecting failure modes, or to introduce component redundancy and/or diversity. With the right domain experts working together performing systematic analysis, designers can gain confidence that all failure modes have been assessed. By identifying design

problems at an early stage, decisions can be made confidently in a timely manner. FMEA/FMECA can also be used during operation to develop effective maintenance procedures through knowledge of the component flaws. FMEA/FMECA will identify likely sources of failure, and aim to suggest improvements in the interest of producing safer, more reliable components for cost-efficient operation.

What we do

CRA can carry out stand-alone FMEA/FMECA studies or use the results of these studies, in conjunction with other failure analysis methods such as Fault Tree Analysis, to produce a complete reliability assessment for a given component, process or system.

Our work

Our key team members have performed FMEAs/FMECAs on many systems and components. These include:

Project Description	Outcome
An FMEA was performed on the interlock system used to protect against dock flooding at a submarine berthing facility.	To inform the FMEA, CRA staff visited the berthing facility and discussed operating procedures with facility staff. This was important to the outcome of the FMEA and it identified that a number of operator actions were claimed as part of the overall protection.
Chloride ingress protection systems are used in conventional and nuclear power stations to protect boilers from seawater ingress. CRA led an FMEA workshop with station engineers and system experts to identify the potential failure modes of an existing protection system design.	The output from the FMEA formed the basis of a fault tree analysis which was used to determine the overall reliability of the system. The results of this analysis confirmed whether the system reliability requirements, as specified in the boiler tube failure safety case, could be met with the current design.
An FMEA was carried out for a proposed nitrogen storage and vaporisation facility designed to be able to supply both low and high pressure nitrogen.	The FMEA provided invaluable insights to the system design process. Of particular note, the FMEA helped to identify single points of failure in the system, which would have violated the project's design safety principles.
CRA led an FMEA on a Heating, Ventilation and Air-Conditioning (HVAC) system being used as part of a new nuclear power station design. The FMEA was carried out to identify failure modes that could lead to potential regulatory issues with the proposed design.	CRA has extensive experience of working within the UK regulatory framework. This experience, together with our involvement with the FMEA, allowed us to influence the system design decisions being made. The identification and resolution of issues at an early stage of the lifecycle reduced the risk of costly re-designs later on.
Perform an FMECA for C&I equipment used to actuate safety significant components.	Common Cause Failures (CCFs) of the C&I equipment was a particular concern in this case. CRA provides significant expertise in this area.