FORMAL SAFETY ASSESSMENT

BASIC GLOSSARY OF TERMS

This document has been developed to expand and further clarify the definitions contained in MSC/Circ.1023-MEPC/Circ.392 on Guidelines for FSA for Use in the IMO Rule-making Process, based on IACS experience in applying FSA. In developing this document, attention has been paid to keep to a minimum modifications to the basic definitions already included in the MSC/MEPC/Circular.

Term	Definition
Absolute Probability Judgment (APJ)	A group of techniques that utilize expert judgment to develop direct numerical estimation of human error probabilities when no relevant data exists for the situation in question. Elicitation techniques like e.g. Delphi Technique, Nominal Group Technique, Paired Comparison, etc. may be used.
Accident	An unintended event involving fatality, injury, ship loss or damage, other property loss, damage or environmental damage.
Accident category	A designation of accidents according to their nature, e.g. fire, collision, grounding, etc. *(For example:* • Collision: striking or being struck by another ship, regardless of whether under way, anchored or moored (this category does not include striking underwater wrecks). • Grounding: being aground or hitting/touching shore or sea bottom or underwater objects (wrecks, etc.). • Contact: striking any fixed or floating object other than those included under "Collision" or "Grounding". • Fire or explosion: accidents where fire or explosion is the initial event. • Missing: ship whose fate is undetermined with no information having being received of conditions and whereabouts after a reasonable period of time. • War losses or damage as a result of hostilities. • Loss of structural integrity: structural failure that can result in the ingress of water and/or loss of strength and/or stability. • Flooding: the ingress of water that can result in foundering or

	sinking of the ship. • Foundering: sinking as a result of heavy weather, springing of leaks, breaking into two, etc.)
Accident scenario	A specific sequence of events from an initiating event to an undesired consequence.
ALARP	ALARP (As Low As Reasonably Practicable) refers to a level of risk that is neither negligibly low nor intolerably high, for which further investment of resources for risk reduction is not justifiable.
ALARP Principle	Risk should be reduced to As Low As Reasonably Practicable (ALARP) level considering the cost effectiveness of the risk control options.
Availability	Availability of a system or equipment is the probability that it is not in a failed state at a point in time.
Brainstorming	Brainstorming is used to identify possible solutions to problems and potential opportunities for improvement. Brainstorming is a technique for tapping the creative thinking of a team to generate and clarify a list of ideas, problems and issues. In applying brainstorming, two phases are involved: a) the generation phase (diverging phase) the facilitator reviews the guidelines for brainstorming and the purpose of the brainstorming session, then the team members generate the list of ideas. The objective is to generate as many ideas as possible. b) the clarification phase (converging phase) the team reviews the list of ideas to make sure that everyone understands all ideas. The evaluation of ideas will occur when the brainstorming session is completed.
Casualty	Serious or fatal accident.
Checklist Analysis (in HAZID)	An experience-based method involving a written list of items or procedural steps to identify known types of hazards, design deficiencies, potential accident scenarios associated with equipment, systems or operations.
Common Cause Failures (CCF)	Conditions which may result in the simultaneous failure of more than one component, subsystem or system, i.e. they can defeat multiple layers of protection simultaneously. CCFs can originate from the environment (e.g. fire, flood), design deficiencies, manufacturing errors, test/maintenance, operational errors, etc.
Consequence	The outcome of an accident, there may be different possible consequences, e.g. human fatalities (or injuries), environmental

	pollution, loss / damage to property
Cost Benefit Analysis	Rational and systematic framework for evaluating, in a directly comparable monetary unit of measurement, advantages and disadvantages of alternative risk control options (RCOs).
Cost Effectiveness Analysis (CEA)	Presents a ratio of Costs to benefits without converting the benefits (e.g. lives saved) to monetary units; the value judgment being left to the decision-maker when implementing the RCOs.
Error	A departure from acceptable or desirable operation (for example of a component or system) that can result in unacceptable or undesirable consequence.
Error Producing Condition	Factors that can have a negative effect on human performance; i.e. conditions that increase the order of magnitude of the error, frequency or probability (similar in concept to Performance Shaping Factors in THERP), for use with the HEART technique.
Event Tree Analysis (ETA)	A method of exploring the development or escalation of an accident, a failure or an unwanted event using a diagram which, commencing with the initiating event, branches at each point of influence of a controlling or mitigating measure until the final outcomes are identified. The probability (or frequency) of success of these measures is indicated allowing for the evaluation of the likelihood of each consequence.
Failure	An occurrence in which a part, or parts of a system ceases to perform the required function.
Failure Mode & Effect Analysis (FMEA)	A process for hazard identification where all conceivable failure modes of components or features of a system are considered in turn and undesired outcomes are noted.
Failure Mode Effect and Criticality Analysis (FMECA)	An FMEA where additionally the criticality of a failure mode or failure cause is assessed by estimating the severity and probability of the failure. Severity and probability are each expressed as ranking indices.
Fault Tree Analysis (FTA)	Fault Tree Analysis (FTA) is a logic diagram showing the causal relationships between events, which singly or in combination result in the occurrence of a higher-level event. It is used to determine the frequency of a "top event" which may be a type of accident or an unintended hazardous outcome.
FN Curve	A graph with the ordinate representing the cumulative frequency distribution of N or more fatalities and abscissa representing the consequence (N fatalities). FN Curve is used for representing societal

	risk.
Formal Safety Assessment	A formal, structured and systematic methodology, currently developed to assist and rationalize rule-making processes and to facilitate proactive risk control.
Frequency	The number of occurrences per unit time (e.g. per year).
Function	An aspect of the intended purpose/task of a system.
Generic Model	A set of functions common to all ships or areas under consideration.
Gross Cost of Averting a Fatality (GCAF)	A cost effectiveness measure in terms of ratio of marginal (additional) cost of the risk control option to the reduction in risk to personnel in terms of the fatalities averted, i.e. $$GCAF = \frac{\varDelta Cost}{\varDelta Risk}$$

Hazard	A potential to threaten human life, health, property or the environment, e.g.
	
	 • Hazards external to the ship: storms, lightning, poor visibility, uncharted submerged objects, other ships, war, sabotage etc.
	 • Hazards on board a ship:
	   o In accommodation areas: combustible furnishings, cleaning material in stores, oil/fat in galley equipment etc.
	   o In deck areas: cargo, slippery deck due to paint / oils / grease / water, hatch covers, electrical connections etc.
	   o In machinery spaces: cabling, fuel & diesel oil for engines, boilers, fuel oil piping & valves, oily bilge, refrigerants etc.
	   o Sources of ignition: naked flame, electrical appliances, hot surface, sparks from hot work or funnel exhaust, deck & engine room machinery.
	 • Operational hazards to personnel: Long working hours, life boat drill, working on deck at sea, cargo operation, tank surveys, on-board repairs, etc.

Hazard and Operability Study (HAZOP)	A study performed by application of guidewords to identify the deviations from the intended functions of a system which have undesirable causes and effects for safety and operability.
Hazardous situation	A situation with a potential to threaten human life, health, property or the environment.

Human Element	It is a complex multi-dimensional issue that affects maritime safety and marine environment pollution. It involves the entire spectrum of human activities performed by the ship's crew, shore-based management, regulatory bodies, recognized organizations, shipyards, legislators, and other relevant parties, all of whom need to co-operate to address human element issues effectively. [IMO Resolution A.850(20), Annex, Principles (a)].
Human Error	A departure from acceptable or desirable practice on the part of the individual or group of individuals that can result in unacceptable or undesirable risks.
Human Error Assessment Reduction Technique (HEART)	A technique to arrive at the human error probabilities by matching the task being assessed to one of the nine generic task descriptions from a given database and then to modify the human error probabilities (HEPs) according to the presence and strength of the identified error producing conditions (EPCs).
Human Error Consequence	The undesired consequence of human error.
Human Error Probability (HEP)	Ratio of the number of human errors that have occurred to the number of opportunities for human error.
Human Error Recovery	The potential for the error to be recovered, either by the individual or by another person, before the undesirable consequences are realized.
Human Factor	The discipline concerned with the design & operation of technological and organizational systems to achieve proper adaptation of human tasks. [Taken from Loss Prevention in the Process Industries, F.P. Lees, Vol. 1, Chapter 14, 14/5] Human Factors are dealt with through ergonomic principles.
Human Reliability	The probability that a person (a) correctly performs some system related activity within the specific time period and (b) does not perform any extraneous activity that can degrade the system
Human Reliability Analysis (HRA)	A process comprising a set of activities as well as the potential use of a number of techniques to derive the human error probabilities (HEPs) so as to incorporate them into a qualified or quantified system model e.g. a fault tree or an event tree.
Incident	An unforeseen or unexpected event which may have the potential to become an accident but in which injury to personnel and/or damage to ship or to the environment does not materialize or remained minor.
Individual Risk	Risk as experienced by an individual e.g. onboard a ship (crew or passenger or belonging to third parties that could be affected by a ship

	accident).
Initiating event	The first of a sequence of events leading to a hazardous situation or accident.
Net Cost of Averting a Fatality (NCAF)	A cost effectiveness measure in terms of ratio of marginal (additional) cost, accounting for the economic benefits of the risk control option to the reduction in risk to personnel in terms of the fatalities averted, i.e. $$NCAF = \frac{\Delta Cost - \Delta EconomicBenefit}{\Delta Risk} = GCAF - \frac{\Delta EconomicBenefit}{\Delta Risk}$$
Performance Shaping Factors (PSFs)	Factors such as experience, situational stress, work environment, individual motivation, human-machine interface, etc. that can have a positive or negative effect on human performance.
PLL (Potential Loss of Life)	The expected number of fatalities (e.g. per ship year).
Reliability	Reliability is a probability of desired performance over time in a specified condition e.g. machinery or system reliability, structural reliability, human reliability. Reliability = 1 - Failure Probability
Risk	Risk is a measure of the likelihood that an undesirable event will occur together with a measure of the resulting consequence within a specified time i.e. the combination of the frequency and the severity of the consequence. (This can be either a quantitative or qualitative measure.)
Risk Assessment	An integrated array of analytical techniques, e.g. reliability, availability & maintainability engineering, statistics, decision theory, systems engineering, human behaviour etc. that can successfully integrate diverse aspects of design and operation in order to assess risk.
Risk Contribution Tree (RCT)	A sequential logic tree structure (Risk Model) consisting of a) Fault Trees from basic events to outbreak of the categories and sub-categories of accidents, and b) Event Trees from outbreak of the categories and sub-categories of accident to final outcomes.
Risk Control Measure (RCM)	A means of controlling a single element or risk; typically, risk control is achieved by reducing either the consequences or the frequencies; sometimes it could be a combination of the two.

Risk Control Measure Attributes	Categorization of RCMs in terms of: • How it works (Category A) • How it is applied (Category B) • How it would operate (Category C)
Risk Control Option (RCO)	An appropriate combination of risk control measures RCMs
Risk Evaluation Criteria	Standards, which represent a value-judgment opinion, usually that of a regulation, of how much risk is tolerable. These are the values used as limits for risk acceptance.
Safety	Absence of unacceptable levels of risk to life, limb and health (from unwillful acts).
Security	Absence of risk to life, health, property and environment from willful acts of individual(s).
Societal Risk	Average risk, in terms of fatalities, of groups of people (e.g., port employees, crew or even society at large) exposed to an accident scenario (cf. individual risk) usually presented in form of F-N Curve (see above definition).
Task Analysis (TA)	A collection of techniques used to compare the demands of a system with the capabilities of the operator, usually with a view to improving performance, e.g. by reducing errors.
Technique for Human Error Rate Prediction (THERP)	A comprehensive methodology covering task analysis, human error identification, human error modeling and human error quantification. It is best known for its human error quantification aspects through its human error probability (HEP) data tables and data quantifying the effects of various performance shaping factors (PSFs) that influence human errors at the operator level.
What-if Analysis	An approach in which a group of experts identify hazards and their consequences, safeguards and possible risk reduction measures related to a function or system based on answering questions that begin with "What if...".