Table 1. Performance Standard for Consequence Analyst FM 00

Level name	Awareness
Code	FM 00
Functionality	Identification of fire and explosion problems

Performance

ID	Area	Skill required	Knowledge required
1 PERFORMANCE OBJECTIVE		Identify the existence of Fire Protection / Fire Safety Engineering profession	
1.1	GENERAL	Mention at least one professional association in fire safety (e.g. SFPE)	What is a professional association and its importance in the industry.
1.2	GENERAL	Understand the need to require the intervention of a competent engineer for the solution of problems related to fires and explosions.	What is a competent engineer in fire and explosion safety

ID	Area	Skill required	Knowledge required
2 PERFORMANCE OBJECTIVE		Identify the need for analysis to solve an industrial problem	
2.1	GENERAL	Identify when a situation or condition may lead to industrial problems	Requirements of their industrial sector (e.g. Food, Energy, *retail*) Events in your industrial sector
2.2	GENERAL	Mention at least one technique and one tool used for an analysis.	Existence of different techniques and tools to perform an analysis.
3 PERFORMANCE OBJECTIVE		Recognize the complexity involved in analyzing the consequences of fires and explosions.	
3.1	GENERAL	Mention at least one complex system in its industrial area and explain the reason for its complexity	Definition of complexity
3.2	GENERAL	Relate the concept of complexity to the problem of fires and explosions.	The problem of fires and explosions. The interaction of factors involved in dynamic fires and explosions.
3.3	GENERAL	Identifies the difference between prescriptive design and *performance-based design*	Concept of prescriptive design, performance-based design and its main differences.

Table 2. Performance Standard for Consequence Analyst FM 01

Level name	Support
Code	FM 01
Functionality	Support in the modeling of fires and explosions

Performance

ID	Area	Skill required	Knowledge required
1	PERFORMANCE OBJECTIVE	Contribute to projects led by their colleagues FM 02 or FM 03	
1.1	GENERAL	Properly use the concepts during the development of projects. Properly use the input parameters to the models of fires and explosions of interest.	Fundamentals of fire and explosion science Input parameters of fire and explosion models.
1.2	FIRE	Describe pool fire, jet fire, and flash fires and their main differences from each other. Gather in technical coordination with FM 02 or FM 03 the evaluation of the flux necessary for a study.	Characteristics and properties of pool fire, jet fire and flash fire. Flux concept Ranges of exposure to thermal radiation and its effects on people and materials.

ID	Area	Skill required	Knowledge required
1.3	EXPLOSIONS	Recognize the main differences between the four different types of explosions Gather in technical coordination with FM 02 or FM 03 the evaluation of explosions	Types of explosions and their differences (VCE, BLEVE, Burst explosion and combustible dust explosions) Notion of the effects of confinement, congestion, and fuel on vapor cloud explosions (VCE). Notion of the phenomenon of BLEVE and out-of-control chain reactions inside reactors. Impossibility of modeling combustion dust explosions.
1.4	LEAKAGE AND DISPERSION	Recognize the input parameters gas release and dispersion models Gather in technical coordination with FM 02 or FM 03 the evaluation of the dispersion necessary for the study	Notion about the impact of wind speed and atmospheric stability on the extent of a scenario Density and linear momentum (e.g. leakage from pressure vessel versus atmospheric evaporation) Types of dispersion (impulse and passive: neutral, high and dense) Flammability ranges
2	PERFORMANCE OBJECTIVE	Properly initiate verification activities stated in the Quality System	
2.1	QUALITY	Recognize the limits of their competences	Quality management system implemented by the organization
2.2	QUALITY	Request support from their colleagues in category FM 02 or 03.	
2.3	QUALITY	Recognize their role as initiator of the quality process	

ID	Area	Skill required	Knowledge required
2.4	QUALITY	Recognize the importance of the quality process	
3	PERFORMANCE OBJECTIVE	Recognize the role of fire modeling within the scope of fire protection systems analysis	
3.1	GENERAL	Describe how fire and explosion modeling is used in performance-based design	Performance-based design concept

Table 3. Performance Standard for Consequence Analyst FM 02

Level name	Skill
Code	FM 02
Functionality	Independently develop and lead consequence analysis studies

Performance

ID	Area	Skill required	Knowledge required
1 PERFORMANCE OBJECTIVE		Master models and their application through computational tools	
1.1	GENERAL	Understand the range of application and limitations of various computational tools for each area	Input parameters of fire and explosion models, the interaction between them and the model and how these affect the results Characteristics, use and limitations of phenomenological models
1.2	GENERAL	Understand the range of application and limitations of the models in each area	
1.3	GENERAL	Use the computational tool without supervision	
1.4	GENERAL	Commission analysis using CFD tools involving complex geometries, mitigation measures, and risk-based study relationships.	Features, use and limitations of CFD tools
1.5	FIRE	Commission or execute fire and smoke modeling	Combustion chemistry, flammability hazard, gasification, heat transfer fundamentals, pyrolysis, species production chemistry, smoke point

ID	Area	Skill required	Knowledge required
1.6	Discharge and dispersion	Commission or execute leakage and dispersion modeling Describe how wind speed and atmospheric conditions can affect the extent of a scenario Describe how density and linear momentum influence the dispersion of substances in both liquid and gaseous states. Recognize dangerous concentration levels of flammability Describe the main differences between the phenomena of gaseous and liquid discharge and the phenomenon of instantaneous vaporization (flashing) and expansion	Fluid Dynamics Thermodynamics Instant gasification (flashing) Vaporization Ignitability (ease of ignition) Ignition time Atmospheric stability Impact of wind speed on stage extension Concentration levels relevant to flammability hazards. Difference between discharge phenomena (gaseous, liquid and instantaneous evaporation) Flammability ranges and their mixing rules Discharge and dispersion models
1.7	EXPLOSIONS	Commission or execute explosion modeling Describe the effects of confinement and fuel origin on vapor explosions.	Explosion dynamics Concept of confinement, congestion, fuel and its effects on steam cloud explosions (VCE)

ID	Area	Skill required	Knowledge required
		Describe explosions, as well as the factors that influence them Identify the appropriate model according to the case and its limitations	Definition and characteristics of the various types of explosions (VCE, BLEVE, Burst explosions, combustible dusts) Definition and differences between the phenomenon of BLEVE and out-of-control chain reactions inside reactors. Explosion models and their applications
1.8		Identify scenarios produced as consequences of the results obtained in another model (e.g., dispersion model that feeds the explosion model)	Interrelation between the different models of consequences (dispersion, explosion, and fire)
2 PERFORMANCE OBJECTIVE		Define the effects of consequences on people, equipment, and structures	
2.1	HEAT	Define the effects that thermal radiation can exert on people, structures, and industrial equipment. Identifies flammability ranges for substances	Critical ranges of exposure to thermal radiation and its effects on people and materials Flammability ranges
2.2	EXPLOSIONS	Define the effects that overpressure can have on people, structures, and industrial equipment	Concept of overpressure, peak pressure and reflected pressure and momentum Phases of the explosion Impulse vs overpressure graph Vulnerability of various types of structure

ID	Area	Skill required	Knowledge required
2.3	SMOKE	Define the effects that smoke can have on people and escape routes	Toxicology of species produced in a fire
2.4	ESCALATION	Identify when an escalation is possible	Concept of escalation, various types of escalation and their impact criteria that can result from fires and explosions.
3 PERFORMANCE OBJECTIVE		Execute developed guides and standards	
3.1	GENERAL	Implement the organization's guidelines and standards.	Content of guides and standards of the organization
3.2	QUALITY		Concept of policy, standard, procedure, code and good practices and their differences.

ID	Area	Skill required	Knowledge required
4 PERFORMANCE OBJECTIVE		Guide and advise other disciplines in their area of expertise	
4.1	GENERAL	Discuss lessons learned from cases and documented experiences	Cases and documented experience of major events
4.2	GENERAL		Metrics and indicators
5 PERFORMANCE OBJECTIVE		Review models results produced by FM 01 and third parties	
5.1	QUALITY	Discern whether a result is consistent with the behavior of the phenomenon given the existing conditions	All of those established at this level
5.2	QUALITY	Understand what is practical for the results obtained from the models, what is significant and what contributes to safety	
5.3	QUALITY	Recognize their role as a reviewer of the works executed by their colleagues FM 01 and third parties	Quality management system implemented by the organization

Table 4 Performance Standard for consequence analyst FM 3

Level name	Leadership
Code	FM 03
Functionality	Develops and leads strategies related to consequence analysis. It is a technical authority on issues related to consequence analysis

Performance

ID	Area	Skill required	Knowledge required
1 PERFORMANCE OBJECTIVE		Provide support, advice and guidance on issues related to consequence analysis	
1.1	GENERAL	Guide and advise on problem solving, from simple to complex or unusual scenarios	Advanced FM 02 knowledge
1.2	GENERAL	Communicate effectively considering the audience	
1.3	GENERAL	Interpret the body language of the audience and adapt the message accordingly	
1.4	GENERAL	Use emotional information to manage or adjust emotions	
2 PERFORMANCE OBJECTIVE		Use modeling principles to solve problems in unusual ways	
2.1	GENERAL	Use critical and analytical thinking as a means of problem solving	Scientific method and its application

ID	Area	Skill required	Knowledge required
2.2	GENERAL	Use deductive reasoning to interpret and analyze the given information	Deductive and inductive reasoning Thermodynamics and advanced transport phenomena, including the phenomenon of combustion.
3 PERFORMANCE OBJECTIVE		Develop and interpret policies, procedures, standards, and good practices	
3.1	QUALITY	Define guidelines for the organization's quality management system	Quality management systems Continuous improvement systems Decision-making methodologies and techniques Principle of project management Techniques for managing recommendations and actions Development of standards and technical writing.
3.2	QUALITY	Define the type of document (policy, procedure, standard and good practices) according to the objective to be applied	
3.3	QUALITY	Identify gaps and improvements to different types of documents (policy, procedure, standard and good practices)	

ID	Area	Skill required	Knowledge required
4 PERFORMANCE OBJECTIVE		Provide trainings, courses, talks and conferences	
4.1	TRAINING	Define program lessons and plans	Teaching methodology tools
4.2	TRAINING	Communicate effectively considering the audience	
4.3	SOFT SKILLS	Interpret the body language of the audience and adapt the message accordingly	Body language and professional profiles
4.4	SOFT SKILLS	Use emotional information to manage or adjust emotions	
4.5	GENERAL	Identify knowledge and skills gaps between FM 01 and FM 02 and develop professional improvement programs	Teaching methodology tools
5 PERFORMANCE OBJECTIVE		Verify and validate the computational methodologies and tools used	
5.1	QUALITY	Conduct the verification and validation process	Verification and validation methodologies and their acceptance criteria