RDCG (Rotterdam Capacity Growth) – DEFINITION PHASE
NESTE

ACTIVE FIRE PROTECTION PHILOSOPHY

REV.	DATE	STATUS	WRITTEN BY (name & visa)	CHECKED BY (name & visa)	APPROV./AUTHOR. BY (name & visa)
	2-9-2021	issued for local authorities			
			Chiara Poggi 2021.08.03 09:02:34 +02'00'	Signed By 2E	2E
E	02/08/2021	ISSUED FOR FEED	2E		2E
D	24/06/2021	ISSUED FOR FEED			
C	25/01/2021	ISSUED FOR BASIC DESIGN			
B	16/11/2020	ISSUED FOR BASIC DESIGN (GENERAL REVISION)			
A	06/08/2020	ISSUED FOR REVIEW			

DOCUMENT REVISIONS

INDEX

1. GENERAL

1.1. Introduction and Project Scope of work

Neste has a target to increase its renewable diesel production capacity in Rotterdam with a new NEXBTL2 Unit; in particular the units in RDCG scope of work are:

- Units in MNA Area:
  - Process Units:
    - Heat Treatment Unit (HTU) Unit 11;
    - Pre- Treatment Unit (PTU) Unit 12;
    - NExBTL 2 Unit 21;
    - Hot oil Unit Unit 57;
  - Auxiliary Units, Utilities and Offsites:
    - MNA Tank Farm Unit 42;
    - MNA Utilities Unit 53;
    - Waste Water Handling (MNA) Unit 62;
    - Flare System Unit 67;
    - Fire Water Unit 86;
  - Other Units:
    - Technical Buildings (MNA) Unit 76;
    - MNA Interconnecting Unit 81;
    - Corridor Interconnecting Unit 82,
- Units in Existing Refinery:
  - Auxiliary Units, Utilities and Offsites:
    - Refinery Tank Farm (existing) Unit 40;
    - Refinery Tank Farm (new) Unit 41;
    - Jetty Loading Expansion Unit 45/46;
    - Refinery Utilities Unit 52;
    - Refinery Waste Water Treatment Unit 60;
      (note: only new lifting station)
  - Other Units:
    - Civil/Industrial Buildings Unit 70;
    - Technical Buildings (Refinery) Unit 75;
    - Refinery Interconnecting Unit 80.

The expansion facilities will comprise, in terms of civil works, also the provision of:

- revamping/extension/refurbishing of existing buildings in the Refinery Area: Secondary Substation SS-6, Operation Building Centre and offices;
- new building at MNA: Substations SS-12 and SS-13 and combined laboratory and operator building.

1.2. Scope of Present Document

Present document establishes the design criteria related to Active Fire Protection to be adopted during Project development.
Deviation from requirement established in present document shall be approved by Neste and documented.

1.3. Fire Protection Workflow

The general approach to fire protection at Neste is HAZARD based and the active fire protection approach is:

- Active Fire Protection Standard sets basic requirements for the fire water system (basis for capacity definition, deluge, etc.)
- Active Fire Protection System Integrity Assurance Standard sets basic requirements for testing etc.

Fire Protection Design Process for new installations is as follows:

1. Define the fire scenario area(s).
2. Identify fire hazard (fire type and duration of fire i.e. scenario) of equipment based on content (chemical properties and process conditions) and equipment type ("FHA part 1").
3. Perform "Consequence Analysis" of potential accident originated by hazardous equipment.
4. Perform "Major Hazard Identification" and "Layout Risk Analysis" for new units/major equipment - avoid domino effects and ensure adequate separation distances.
5. Develop preliminary design for fire protection.
    a. Fireproofing shall be uniform for the whole structure and shall be based on fire scenarios (or 30 min jet + 60 min pool fire) according to L104.
    b. Identification and definition of fireproofing/protection of Safety Critical Equipment needed for safe unit shut down.
    c. Firefighting system design shall be designed according to Active Fire Protection Standard as a minimum, including also requirements from Dutch legislation or regulations (refer to para 1.6).
    d. Definition of Gas Detectors, Fire Detectors and Surveillance Cameras shall be based on (fire) hazard of equipment and experience. FHA and HAZOP shall give the input to equipment amount and locations.
6. Perform "FHA part 2" to check that the preliminary design is adequate to detect fires and leakages and to prevent escalation of the situation to adjacent equipment and/or units.
7. Perform "HAZOP and LOPA" (typically HAZOP identifies some additional detection needs).
8. Modify design based on PHAs (i.e. FHA, HAZOP and AEA) results.
9. Generate Fire Pre Plan and Fire protection documents (description of the systems).
10. Verify the integrity of fire protection equipment.

1.4. Updating of Present Document

Present document may be updated during Project development on the basis of review/analysis developed according to Ref. [4] as described in above paragraph 1.3.

1.5. Acronyms and Abbreviations

AEA	Action Error Analysis
AFP	Active Fire Protection
API	American Petroleum Institute
EI	Energy Institute
EN	European Norm
FHA	Fire Hazard Analysis (note: in current revision of Six Step Procedure (ref. [4]) the analysis is called Fire Risk Analysis, anyhow Neste informed that proper name which will be used in future is Fire Hazard Analysis)
HAZOP	HAZard and OPerability
HSE	Health Safety Environment
HTU	Heat Treatment Unit
LOPA	Layer Of Protection Analysis
MNA	Maasvlakte New Area
NFPA	National Fire Protection Association
PGS	Publicatiereeks Gevaarlijke Stoffen
PHA	Process Hazard Analysis
PTU	Pre Treatment Unit
RJF	Renewable Jet Fuel

1.6. Applicable Codes, Standard and Guidelines

This philosophy contains the necessary aspects for the preliminary design of the firefighting system and equipment. It is mainly based on: NMS ID: 54751170 (rev.1) Active Fire Protection (Standard) which is presented as Attachment 1 to present document; the present philosophy provides clarification and integration to NMS ID: 54751170 to tailor its applicability on Project, in addition present document is updated, if required, as explained in above paragraph 1.4.
For additional requirements not covered by the present philosophy, the following have to be taken into account (in order of priority):

Local codes and referenced document:

PGS 29: 2016	Directive for aboveground storage of flammable liquids in vertical cylindrical tanks
PGS 19: 2013	Propane and butane: storage
PGS 31: 2018	Overige gevaarlijke vloeistoffen: opslag in ondergrondse en bovengrondse tankinstallaties
EI 19: 2012	EI Model code of safe practice part 19: fire precautions at petroleum refineries and bulk storage installations
Bouwbesluit 2021	Building Decree

Neste standards:

NMS ID: 54751174 (rev.1)	Active Fire Protection Integrity Assurance (Standard)
W-103 (rev.9)	Layout Design Specification
H-110 (rev.10)	Underground Piping Design

EN codes:

EN 13565-2: 2018	Fixed firefighting systems – Foam systems part 2 – Design, construction and maintenance
EN 12845: 2020	Fixed firefighting systems – Automatic sprinkler systems – Design, installation and maintenance
EN 694: 2014	Fire- fighting hoses – semi-rigid hoses for fixed systems

NFPA standards:

NFPA 10: 2018	Standard for Portable Fire Extinguishers

NFPA 11: 2016	Standard for Low, Medium, and High-Expansion Foam
NFPA 13: 2019	Standard for the Installation of Sprinkler Systems
NFPA 14: 2019	Standard for the Installation of Stand Pipe and Hose System
NFPA 15: 2017	Standard for Water Spray Fixed System for Fire Protection
NFPA 20: 2019	Standard for the Installation of Stationary Pumps for Fire Protection
NFPA 24: 2019	Standard for the Installation of Private Fire Service Mains and Their Appurtenances
NFPA 2001: 2018	Standard on Clean Agent Fire Extinguishing Systems
API standards:	
API 2001: 2019	Fire Protection in Refineries
API 2030: 2014	Application of Fixed Water Spray Systems for Fire Protection in the Petroleum and Petrochemical Industries

1.7. References

Present document should be read in conjunction with:

Ref [1] HSE Design Criteria (082755C-000-JSD-1900-0003)

Ref [2] Passive Fire Protection Philosophy (082755C-000-JSD-1980-0001)

Ref [3] Fire & Gas Detection Systems Philosophy (082755C-000-JSD-1950-0001)

Ref [4] Six Step Procedure in Plant Investment Projects (Standard) NMS ID: 20169829 version 7

Ref [5] Process Description MNA Fire Water Unit 86 (082755C-086-CN-0009-0001)

Ref [6] Basis of Design (082755C-000-CN-0007-0001)

2. PURPOSE AND SCOPE [1]

Refer to paragraph 2 of NMS ID: 54751170.

[1] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
Present document is intended as providing instruction/clarification to NMS ID: 54751170; any deviation from NMS ID: 54751170 shall be documented and approved by Neste. Present document chapters numbering and title from n° 2 onward makers reference to relevant chapter of NMS ID: 54751170.

3. RESPONSIBILITIES [2]

Refer to paragraph 3 of NMS ID: 54751170.

[2] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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4. MINIMUM REQUIREMENT [3]

Refer to paragraph 4 of NMS ID: 54751170.

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5. FIRE PROTECTION GENERAL PRINCIPLES [4]

Refer to paragraph 5 of NMS ID: 54751170.

[4] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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6. ACTIVE FIRE PROTECTION BASIC APPLICATION AND OBJECTIVES [5]

Refer to paragraph 6 of NMS ID: 54751170.

[5] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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7. AFP DESIGN CRITERIA[6]

Refer to paragraph 7 of NMS ID: 54751170, with the following clarification:

- for fire proofing of above ground fire protection elements and their support refer to Ref. [2].

[6] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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8. SELECTION OF EXTINGUISHING/COOLING AGENTS[7]

Refer to paragraph 8 of NMS ID: 54751170, with the following clarifications:

- Fire water: for water quality refer to Ref. [6];
- Steam: Snuffing steam shall not be provided on fired heaters according to current Neste instruction. The risk of liquid water delivered to the furnace is considered higher by Neste than the benefit of providing snuffing by steam in case liquid pool is formed in the furnace chamber by leakage/rupture of tubes or by presence of liquid in the fuel gas.

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9. FIRE WATER DEMAND CALCULATION[8]

Refer to paragraph 9 of NMS ID: 54751170, with the following clarifications:

- Fire scenario in storage atmospheric tank area:
  - fire scenario like bund fire and tank fire are not considered credible for Intermediate tank farm (in Unit 42, Intermediate tanks 42FB-01 and 42FB-02), Diesel tank farm (in Unit 41, Renewable Diesel tanks 41FB-06 and 41FB-07) and Hot Oil Storage tank 57FB-01 (in Unit 57);
  - fire scenarios like bund fire and tank fire are considered credible for Renewable Jet Fuel tanks 41FB-04 and 41FB-05 and Renewable Diesel/Jet Fuel tanks 41FB-08 and 41FB-09 (in Unit 41);
  - fire scenarios like bund fire and rim fire are considered credible for Bio-Naphtha tank 40FB-20 (in Unit 40).
- Fire area:
  - for process, utilities and pumping station the fire area is assumed to be the surface corresponding to the sum of the areas drained into relevant catch basins, depending on the leakage locations, up to maximum 4 adjacent catch basins;
  - for storage bund or other diked area the fire area is assumed to involve the entire bund/dike minus the area occupied by tanks installed in the bund or diked area,
  - for fixed roof tank the fire area is assumed to involve the entire tank internal surface (for floating roof tank, the tank fire scenario is assumed not credible),
  - for floating roof tank fire area scenario is assumed involving only the rim area.
- During the tank fire scenario no cooling of the tank on fire is assumed, as cooling water can cause unwanted temperature related stresses in the tank wall.
- During tank bund fire scenario no cooling of the storage tanks inside the bund on fire is assumed, as the cooling water will have a detrimental effect on the creation and stability of the foam provided in the bund.
- Minimum water application rates, for process equipment, pumping station and utilities area (where fire is considered possible), are based on NFPA 15 and they shall be considered as follow:
  - Control of burning at pumps or compressors: 20.4 l/min/m2 water spray (to be considered for pump and compressor present in the fire area as well as for those present in 12 meters around the fire area in every direction);
  - Control of burning liquid pool: 12.2 l/min/m2 water spray (to be considered as spray water over the fire area unless specific foam application is provided as per chapter 16);
  - Exposure protection for the whole surface of a process equipment: 10.2 l/min/m2 water spray (to be considered for equipment present in the fire area as well as for those present in 12 meters around the fire area in every direction).
- Minimum water application rates, for storage is as follow:

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- Bio-Naphtha Tank (external): 10.2 l/min/m2 water spray for half tank shell and floating roof (as per existing tank);
- Other atmospheric storage tank (external): 2 l/min/m2 water spray for entire tank shell and fixed roof (as per EI 19) when single portion of the tank or entire surface of the tank is exposed to radiation greater than 10 kW/m2 assuming bund fire scenario or tank fire scenario;
- Bio-Naphtha Tank (internal): water required for foam application considering 12.2 l/min/m2 application rate;
- Other atmospheric storage tank (internal): water required for foam application considering 5 l/min/m2 application rate, as per chapter 16;..
- Storage tank bund: water required for foam application considering 5 l/min/m2 application rate, as per chapter 16.

- Additional flow required for fire brigade shall be considered as follows:
  - 6000 l/min for fire scenarios in storage areas involving Bio-Naphtha Tank 40FB-20, Renewable Jet Fuel tanks 41FB-04 and 41FB-05 and Renewable Diesel/Jet Fuel tanks 41FB-08 and 41FB-09, as per PGS 29;
  - 10000 l/min for all other scenarios where fire is considered possible, as per Neste Standard.

10. MANDATORY ACTIVE FIRE PROTECTION APPLICATIONS[9]

Refer to paragraph 10 of NMS ID: 54751170, with the following deviation:

- Fixed spray water systems on Biopropane storage shall not be provided since the entire storage surface is not exposed to fire condition being the type selected (covered by earth);

and with the following clarifications:

- According to Neste, below definitions are to be adopted for flammable and combustible:
  - Flammable: definition according to the CLP classification (flash point <= 75°C);
  - Combustible: Neste input is to consider flash point < 100° C, but not classified as flammable by CLP.
- General indication is to provide fixed water spray systems to process equipment with flammable content minimum 5 tons of inventory (high inventory) and minimum 10 barg of operating pressure (high pressure);
- Fixed foam systems shall not be considered for Intermediate tanks 42FB-01 and 42FB-02 (in Unit 42), Renewable Diesel tanks 41FB-06 and 41FB-07 (in Unit 41) and for Hot Oil Storage tank 57FB-01 (in Unit 57);
- Fixed foam systems shall be considered for Bio-Naphtha tank 40FB-20 (in unit 40) and Renewable Jet Fuel tanks 41FB-04 and 41FB-05 and Renewable Diesel/Jet Fuel tanks 41FB-08 and 41FB-09 and their bund (in Unit 41); Bio-Naphtha tank 40FB-20 will be served by existing system.

[9] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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11. STEAM RINGS[10]

Refer to paragraph 11 of NMS ID: 54751170.

[10] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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12. FIRE WATER SOURCE, STORAGE AND PUMPING[11]

Refer to paragraph 12 of NMS ID: 54751170, with the following clarification:

- For Fire water storage and pumping systems at MNA refer to Ref. [5].
- Fire water for other new facilities in the Refinery area is provided by existing Neste refinery system: one tank having capacity of 6000 m3 and pumping system having capacity of 3000 m3/h and 9 barg discharge pressure minimum.
- Fire water for all other new facilities in the Refinery area could also be fed (as backup source according to PGS 29) by fire boat connection at Jetty 1.
- Existing fire water storage capacity at Refinery area shall be verified for 4 hours consumption (according to PGS 29) assuming the water required in such period for the related fire scenario; not necessarily all streams contributing to the peak flow rate of water must be considered for the entire 4 hours period (e.g.: the water required for foam is considered only with respect to relevant discharge time).

[11] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
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13. FIRE WATER NETWORK REQUIREMENTS[12]

Refer to paragraph 13 of NMS ID: 54751170.

13.1. Fire Hydrant

Refer to paragraph 13.1 of NMS ID: 54751170; with the following clarifications:
- Dry type hydrant shall be used to prevent freezing during winter condition.
- High capacity FW manifolds to be traced to prevent freezing during winter.
- The hydrant shall be 6" diameter. Hydrant shall be provided with two connections 2½" diameter (except those hydrants serving the storage area where a 4-outlet connection shall be provided) with STORZ coupling with a lug distance of 81 mm.

Refer to paragraph 13.1 of NMS ID: 54751170, with the following deviation:
- Hydrants shall not be installed along entire FW ring: case by case evaluation to be conducted. Distance of 40 m between hydrants is, therefore, not always respected.

13.2. Dry Risers

Refer to paragraph 13.2 of NMS ID: 54751170, with the following clarification:
- 4" dry rising main with 2 ½" (63.5 mm) connections shall be provided for each plant structure higher than 10 m; landing valves shall have STORZ coupling;
- Dry risers are only useful if the Fire Brigade can fight the fire at elevation (fire cannot be too large - safe distance), or that the riser position provides a tactical vantage point to fight a fire from a safe distance.

13.3. Fixed Water Monitors

Refer to paragraph 13.3 of NMS ID: 54751170; with the following clarifications:
- Fixed type monitors, generally installed on hydrant, shall be positioned:
  - to provide water coverage on all process equipment handling flammable / combustible fluid;
  - to provide water for NH3 abatement on SWS column and associated circuit handling toxic gas (NH3);
  - to provide coverage on Diesel and RJF storage tank pumping station;
  - to provide water coverage on equipment handling fluids heated at temperature above flash point minus 22°C (operating temperature > flash point temperature – 22°C), even if not classified as combustible according to Neste (for definitions of combustible refer to paragraph 10).

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- A selected number of monitors shall be remote operated according to results from FHA part 2; those shall be controlled existing Goalkeeper system.
- The monitor shall be drainable to prevent freezing during winter condition.
- The monitor shall be protected from vehicle collision.
- When used for foam coverage the monitor shall be equipped with foam nozzle for foam discharge in potential liquid pool areas, and with local foam container/storage; the foam container/storage and associated elements to the monitor shall be protected by low ambient temperature to ensure proper operation in all conditions.
- High capacity water monitors (6000 l/min at 7 barg) to be provided as resulting from Fire Hazard Analysis part 2 for providing high flow water stream on the point eventually impinged by jet fire scenario to prevent escalation.

13.4. Elevated Fire Water Monitor

Refer to paragraph 13.4 of NMS ID: 54751170, with the following clarification:

- The remote operated monitor shall be controlled from the Goalkeeper system; the remote operation monitor shall have a wireless remote control and hard-wired remote control. Hard-wired remote control shall be located in such a place where it can be operated using CCTV (Closed Circuit Tele Vision) monitoring.

13.5. Water Spray Fixed System

Refer to paragraph 13.5 of NMS ID: 54751170, with the following clarification:

- The Deluge Valve shall be located at least at 15 m from the equipment/area to be protected. In process area if distance between deluge valve and equipment protected is lower than 30 m the deluge valve shall be protected by blast wall/enclosure.
- The Deluge Valve shall be actuated manually (in addition to local device mounted on deluge valve itself) by:
  - dedicated push button located close to the deluge valve itself or to a common panel serving a group of deluge valves;
  - by dedicated push button located in control room.
- Deluge valve may be also be activated automatically by fire and/or gas detection (Ref. [3]).
- Each system shall be provided with breeching inlet just beside the deluge valve (which shall be provided also with manual valve downstream to allow segregation) to enable local fire brigade to charge the water and/or foam solution into the system. The number of inlets shall be adequately designed to ensure water and/or foam solution provision; for storage area the inlet shall be located outside the tank bund, at sufficient distance from the bund and within 10 m from the firefighting vehicle access road.
- Piping from underground network to deluge valve shall be traced to prevent freezing during winter. Deluge valve shall be provided with cabinet to prevent freezing.

13.6. Hose Reel (new paragraph)

Hose reel shall be provided in Compressor Shelter, in PTU building and in fire water pump building.
1 ½" hose (EN 694, type A), 30 m length, shall be mounted in a cabinet and the firefighting water pipe supply shall be 2" (50 mm).
The nozzle of the hose is 6 mm.

13.7. Dry Riser with Breeching Inlet (new paragraph)

Dry Riser with Breeching inlet shall be provided for PTU building and Fire water pump building.
It consist of :

- External two way valves connection (breeching inlet as per BS 5041 Part 3/5) dedicated to fire brigade, located outside enclosure to supply internal 4" dry rising main (foot of the riser stack). The breeching inlet is located no more than 18 m away from any fire engine access way.
- Water landing valve 2½" (instantaneous female coupling) with related fire hose 30 m length located near each floor in a dedicated glass-fronted inlet box.
- Flat folding hose 2 ½" (63.5 mm) with standard (double-pull) release mechanism, located in cabinet at max 3 m from landing valve.

13.8. Sprinkler System (new paragraph)

Sprinkler System shall be provided for PTU building (in case the carrying structure is not fire protected) and Fire water pump building.

Automatic sprinkler system to be designed and installed in line with EN 12845 and NFPA 13 requirement.

14. FIRE EXTINGUISHERS[13]

Refer to paragraph 14 of NMS ID: 54751170, with the following clarifications:

- Two types of extinguishers are used in open areas: Wheeled extinguishers: 50 kg dry chemical; Portable extinguishers: 12 kg dry chemical.
- For PTU building and Fire Water pump Building multipurpose polyvalent dry chemical (12 kg) powder for fire type A, B and C, shall be provided on each floor (hanged on walls), on access stairways (on other support or column), based on site experience.
- Portable fire extinguisher shall be provided inside Substations, Operator Building, Laboratory and in the extension, if any, of existing Substation and existing Operation Building Centre. Type of portable extinguisher depends on building function:
    - in technical buildings, according to the accessibility and size of the rooms to be protected, portable CO2 extinguishers (6 kg) shall be provided;
    - for non-technical rooms (offices, meeting room, etc.) portable (12 kg) dry chemical powder extinguishers shall be provided in the building corridors.

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15. CLEAN AGENT SYSTEMS[14]

Refer to paragraph 15 of NMS ID: 54751170 with the following clarification:

- The provision of total flooding is required in "control room, technical room, electronic cabinet"; hence it can apply on some rooms of Operator Building, Substations (if technical room are present), and extension of existing Substation (if technical room are present) and Operation Building Centre if extension impacts on area to be protected.

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16. FOAM SYSTEMS[15]

Refer to paragraph 16 of NMS ID: 54751170.

16.1. Foam concentrate

Refer to paragraph 16.1 of NMS ID: 54751170.

16.2. Foam storage

Refer to paragraph 16.1 of NMS ID: 54751170.

16.3. Foam pumps and proportioners

Refer to paragraph 16.1 of NMS ID: 54751170.

16.4. Foam solution pipework and foam nozzles

Refer to paragraph 16.1 of NMS ID: 54751170.

16.5. Foam application methods and rates

Refer to paragraph 16.1 of NMS ID: 54751170; with the following deviation (refer to 082755C-RFI-PRO-00001):

- For application rates for storage tanks (internal for bio-naphtha tank, Renewable Jet Fuel tanks and Renewable Diesel/Jet Fuel tanks) and bund the discharge time for fixed foam pourers is 20 minutes instead of 60 minutes;

and with the following clarification:

- In case of floating roof tank, the foam application is 12.2 l/min m2. and it is calculated based on the rim annulus surface

The clarification is only valid, according to EN 13565-2, if the roof construction is:
- steel double deck;
- steel pontoon;
- full liquid surface contact, closed cell honeycomb, of metal construction conforming to API 650, welded steel tanks for oil storage.

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According to Neste definitions, steel double deck and steel pontoon roofs are considered "heavy floating roof" while aluminum roof is considered "light floating roof".

17. PERFORMANCE MEASURING, EVALUATION/VERIFICATION AND REPORTING[16]

Refer to paragraph 17 of NMS ID: 54751170.

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18. DEFINITIONS[17]

Refer to paragraph 18 of NMS ID: 54751170.

[17] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
Present document is intended as providing instruction/clarification to NMS ID: 54751170; any deviation from NMS ID: 54751170 shall be documented and approved by Neste. Present document chapters numbering and title from n° 2 onward makers reference to relevant chapter of NMS ID: 54751170.

19. RELATED DOCUMENTS[18]

Refer to paragraph 19 of NMS ID: 54751170 and to paragraph 1.6 above.

[18] Active Fire Protection shall be done according to Neste Standard NMS ID: 54751170; which is attached to present document as Attachment 1.
Present document is intended as providing instruction/clarification to NMS ID: 54751170; any deviation from NMS ID: 54751170 shall be documented and approved by Neste. Present document chapters numbering and title from n° 2 onward makers reference to relevant chapter of NMS ID: 54751170.

20. ATTACHMENT

Attachment 1: NMS ID: 54751170 version 1

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(attachment 1 includes 18 pages)

Review Status	PUBLISHED

Metadata

Owner	
Author	
Reviewer	
Approver	
Language	English
Type	Standard
Other Information	
NMS ID	54751170
Legacy Document Number	
Business ID	Neste Corporation Business ID FI1852302-9
Related Upper Level NMS Document(s)	Emergency Management (Principle), Asset Integrity Management (Standard)
Related Process(es)	
Related External Standard(s)	

Incoming Links	Incoming Links **Incoming links**
Outgoing Links	Outgoing Links https://nms.neste.com/pages/viewpage.action?pageId=20170051 https://nms.neste.com/pages/viewpage.action?pageId=20169814 https://docs.google.com/spreadsheets/d/1USP7d56c2BlGtSIJq1qyRKe4C9KaEFlCCrnxZSLWLmM/edit#gid=1937830721
Link to This Page	https://nms.neste.com/pages/viewpage.action?pageId=54751170

Table of contents

Appendices

File	Modified

1 Changes

New instruction

Copy a template for self assessment from here: OEMS self assessment template

2 Purpose and scope

Purpose of this standard is to describe requirements for Active Fire Protection applications at Neste sites. Including general principles of fire protection and selection criteria for active fire protection options.

Active fire protection in scope includes , Fire water and foam systems, foam-, dry powder-, clean agent- and gaseous extinguishing systems. Other active fire protection requirements (including Fire and gas detection) are described in *HSE Design Quidelines Standard.*

All active Fire protection solutions shall comply with relevant local regulations, standards and codes of practise.

Although we shall fulfil all the prescriptive requirements set by authorities, a hazard (API2001) based approach shall be always applied to ensure adequate hazard reduction case by case. The need, role and objectives of an Active Fire Protection in overall hazard mitigation shall be assessed and determined based on Fire hazard Assessments. (Fire hazard assessment work instruction CP446)

Active Fire protection system design and integrity assurance process is described in *Active Fire Protection Integrity Assurance Standard*

3 Responsibilities

- Corporate Fire Safety Specialist is responsible to update this document.
- Local owner of the Active Fire Protection arrangements must be clearly stated in local instructions
- Responsibilities for following minimum requirements and other active fire protection related responsibilities must be clearly stated in local instructions

4 Minimum requirements

- Local owner of Active fire protection systems is responsible to conduct self assessment to identify possible gaps in active fire protection.
- Local line organisation is responsible to make a plan and schedule to fill the identified gaps
- Local responsible person for Asset Integrity Management is responsible to ensure that active fire protection systems are classified and treated as Safety Critical Equipment.
- Active fire protection documentation shall be treated as an important part of process safety information.
- Active Fire Protection systems must be included in Management of Change process

5 Fire protection general principles

Early detection of fires and gaseous or liquid releases shall be ensured with hazard based selection and placement of fire and gas detectors.

Passive fire protection (although not in the scope of this document) shall prevent any immediate danger of spreading or collapsing caused by a fire, and to give time for responders to start cooling or extinguishment actions. Passive fire protection includes coated surfaces that protect metal structures or equipment from overheating, adequate safety distances between equipment and drainage system with curbed and sloped fire areas.

Active fire protection requires a separate start-up either manually, automatically triggered by detectors or through a remote control. Fire water system consists of Fire water storage, fire water pumps and main with valves, fire hydrants, water monitors, water sprays or sprinkler systems. In addition, foam, dry powder, clean agent and gaseous extinguishing systems comprise parts of active fire protection.

Systematic approach for Active Fire Protection design and implementation in investment projects is described in corporate standard for *Six step procedure in plant investment projects.*

Active fire protection systems and equipment shall be classified and treated as Safety Critical Equipment (SCE) as described in corporate standard for *Asset Integrity Management*. Asset Integrity Management system shall ensure that the time of SCE impairment is minimized by prioritizing repair and maintenance of SCE.

The role of the fire protection system shall be analysed at the design stage and when specifying the objectives and criteria for fire protection. Thereafter fire protection systems shall be acknowledged ongoing basis as a part of Management of change and hazards assessment procedures. The operational reliability of the system shall be guaranteed through sufficient testing, inspection and maintenance practices that shall be considered already at the design stage.

The hazard-based approach in accordance to Fire Systems Integrity Assurance process shall contain the following stages:

- Assessment of the Fire, Explosion and Toxic hazard and the need for fire protection in order to lower the hazard to an acceptable level
- Definition of role, purpose and objectives that the fire protection system shall fulfill in terms of hazard reduction
- Definition of performance requirements: Functionality, availability, reliability and survivability.
- Identification of different options and the analysis of cost-efficiency
- Selection of the most suitable and purposeful system
- Definition of requirements for single components in the fire protection system
- Development of a proper testing, inspection and maintenance program

6 Active fire protection basic applications and objectives

Following basic applications and objectives shall be the basis for active fire protection design and implementation:

- Protection of personnel shall always be the first priority.
- Active fire protection shall be designed so that safety of the response personnel is not compromised.
- Control and extinguishment of only one fire at a time occurring through the whole plant area.
- Limit fire to the fire area where it started.
- Limit fire to one storage tank without escalation to adjacent tanks.
- Fixed systems that can be activated from a safe location shall be preferred instead of manual intervention with portable equipment.
- Application of low expansion foam to control flammable and combustible liquid hydrocarbon pool fires
- Application of dry chemical powder to control small scale fires.
- Application of spray water to cool exposed structures and equipment
- Application of spray water to control fire radiation to adjacent equipment.
- Application of spray water for toxic gas dispersion (H2S) and dilution (NH3).
- High capacity water monitors for jet fire scenario to prevent escalation. High flow water streams to the point of Jet fire impingement.
- Pressurized gas or liquid fires shall be extinguished by isolating the source by remote operable isolation valve (ROIV, preferred solution) or manually from a safe location while controlling the fire and protect exposures with water application.
- Total flooding by clean agent of control room, technical room, electronic control cabinet and related false floor.

- Steam for small-scale flange fires or preventing ignition or as smothering gas for fired heaters.
- Fire area must be curbed and/or sloped and sewered in a way to manage the maximum estimated leak and fire water application to the area so that the fuel and spent fire water will not spread outside of the fire area.
- Leaked fuel and fire water run off containment and collection requirements are defined in more details in HSE Design Guideline Standard

7 AFP DESIGN CRITERIA

AFP system performance requirements

Active Fire Protection system performance requirements shall be defined, described and documented in design/procurement phase for each active fire protection system. The performance description shall be archived together with other equipment documentation and shall be treated as important process safety information. Performance requirements shall be referred when defining acceptable test results and reviewed during possible management of change process.

Example of water based system performance requirements:

1.Definition of the role of fire protection system:

- Cooling surfaces exposed to heat radiation or flame impingement
- Fire control
- Fire extinguishment
- Gas dispersion/dilution

2. Fire protection system performance requirements:

Functionality:

- Capacity, pressure and flow rate (if applicable)
- Area of coverage
- Application rate
- Fire detection time
- Response time from detection to full operation
- Minimum operation time

Availability:

- Remote controlled, automatic or manual activation
- Safe location of system activation

Reliability:

- System reliability requirement
- Back up arrangements (defined in MOC process) during out of service maintenance or other reasons
- Provisions for ongoing tests during operation
- Provisions for the fire water quality
- Winter conditions shall be taken into account

Survivability:

- Resistance to heat radiation or direct flame impingement prior to activation.
- Consideration of the need for system components passive fire protection
- Above ground fire water piping and supports shall be fire proofed in fire harazardous areas.
- Valves, actuators and cables shall be fire proofed in fire hazardous areas.

3. Component requirements

- Selection of suitable construction materials
- Corrosion resistance
- Component quality and reliability
- Avoidance of blockages

4. Provisions for ongoing test, inspection and maintenance

- Test methods and procedures
- Test connections shall be provided i.e. valves, drains, etc.
- Performance tolerances

The above requirements shall be developed for each system/ subsystem comprising the active fire protection measures, including:

- Firewater pumps, Firewater storage tanks
- Water spray systems
- Hydrants and monitors
- Foam systems
- Clean agent systems
- Mobile firefighting equipment

The reference standards and documents for the specified requirements shall be indicated in the active fire protection performance requirements.

8 SELECTION OF EXTINGUISHING/COOLING AGENTS

Fire Water

Water is the primary agent for exposure cooling and fire control due to its high specific heat and high latent heat of vaporization.

Water source shall be of high quality and free from water treatment chemicals that can be detrimental to foam generation.

Chlorides in firewater increase corrosion effects and aquatic organism can cause detrimental layer accumulation inside the firewater piping.

Water mist

Water mist particles are more like vapour than water thus minimizing collateral damage done by more dense water application. Water mist is prone to airflow, hence suitable only for indoor applications.

Foam

Foam is the most effective agent for two dimensional flammable liquid pool fires. The type of foam must be suitable for flammable substances at the plant. Environmental aspects of foam chemicals shall be considered in the design stage together with firewater run off management.

Dry chemical powder shall be suitable for liquid and gas fires in plant outdoor areas. Compatibility with foam shall be checked. Some dry powders may destroy a foam blanket.

Clean Agent (FM 200, Argon or Inergen) shall be used as extinguishing gas in area/volume total flooding systems. The clean agent must be acceptable in EPA SNAP list of substitutes in total flooding systems

CO2

Carbon dioxide inert systems shall be used only in unmanned closed rooms or enclosed equipment spaces with extra precautions against asphyxiation hazards. Hand held or wheeled CO2 extinguishers for electrical fires.

Steam

Steam can be used as smothering steam in furnace fire boxes and header boxes, with steam rings on equipment flanges and with steam lances for manual intervention for small leaks and fires only.

9 FIRE WATER DEMAND CALCULATION

Maximum fire water flow demand shall be based on the worst single fire scenario on site identified in hazard assessments.

In process areas, the theoretical firewater demand calculation shall be based on the water application rates needed for exposure protection, control of burning and extinguishment inside the fire scenario envelope. The scenario envelope shall cover the whole fire area plus adjacent areas 12 m around in every direction.

Required minimum application rates based on NFPA 15 are as follows:

- Control of burning at pumps or compressors: 20,4 l/min/m2
- Control of burning liquid pool: 12,2 l/min/m2
- Exposure protection for the whole surface of a process equipment: 10,2 l/min/m2

For determination of theoretical fire water demand, the total surface area of the fire scenario envelope and the equipment surfaces inside it shall be calculated and multiply by the above mentioned application rates.

The above mentioned application rates are intended to spread evenly on the protected surface. If firewater monitors are used instead of fixed spray systems, an additional 30% increase shall be calculated due to potential losses in water stream before reaching the target.

The above mentioned rates are not enough to protect against jet fire exposure. Additional high capacity monitors shall be provided to reach potential jet fire targets from two directions. The water flow for the high capacity monitors shall be included in the total fire water demand.

When all fixed on-site water and foam systems for the worst scenario are in operation, an additional 10 000 l/min flow shall be available for fire and rescue service without jeopardizing the flow of the systems in operation.

An additional 10% margin shall be increased to compensate potential loss of ageing system performance.

In storage tank areas the worst case scenario calculation shall include all the fire water flow needed for simultaneous tank and bund extinguishment and for adjacent tanks protective foaming and cooling. Possible high capacity monitors required flow must take in account in calculations. Foam application rates for Tank and Bund fires described in chapter 16.5.

As a summary the total fire water flow shall be determined for the worst scenario as follows:

TOTAL FLOW COMPONENTS	Application rate l/min (or m3/h)
Total flow required for fixed water/foam spray systems	

Total flow required for fire water/foam monitor application(With 30% additional margin)	
Additional flow required for fire brigade	
Ageing safety margin 10%	
TOTAL FIRE WATER DEMAND	(typically 30 000 - 40 000 l/min in refineries)

Required operating pressures and maximum flow velocity

The firewater distribution system shall be designed and confirmed by reliable calculation software (e.g. PIPENET software) in such a way, that flow requirements are met throughout the installation. Pressure at full rate demand shall be 9 barg in farthest take-off point and pipe sizes shall be defined so that residual pressure will be 7 barg with maximum fire water flow added with 20% margin in most remote areas. However flow velocity shall not exceed 3,5 m/s.

10 Mandatory active fire protection applications

As a minimum the following AFP measures shall be in place in following applications:

Fixed water spray systems:

- When it is critical to ensure life safety
- High pressure and high inventory process equipment with flammable content. The shell surface up to 12 m above ground or above any surface where flammable liquids can pooled.
- Pumps handling flammable or combustible liquids and when the fluid temperature is 22 °C or more above its flash point and the pump is in close proximity to other equipment (including adjacent pumps) or structures that could be quickly damaged by the pump fire
- Pumps operating above auto ignition temperature (AIT)
- The water spray system for pumps should envelope the entire pump including the shaft, seals and other leak potential critical parts. Spray nozzle type and position shall be designed to minimize the possibility of thermal shock damages for pumps. A hollow cone type spray nozzle shall be used for hot pump water spray protection.
- LPG pumps
- LPG storage tanks for the whole surface
- LPG loading racks
- Large expensive or hard to replace electric motors, turbines and compressors including their auxiliary systems containing large amounts of possibly burnable fluids (like lube oil) shall be assessed in FHA and protection needs shall be defined.

Fixed foam systems:

- When critical to ensure life safety
- Flammable liquids loading rack

Fixed or semi-fixed foam systems for

- Flammable or combustible liquid storage tanks

Clean agent Total flooding systems:

- In critical electric-, IT-system-, automation- and control rooms

11 STEAM RINGS

Steam ring shall be considered based on fire hazard assessments to piping or equipment flanges, for:

- Hydrogen service regardless the operating temperature
- Process stream handles combustible fluid at operating temperature greater than 250°C or at auto-ignition.

12 FIRE WATER SOURCE, STORAGE AND PUMPING

Water source

Water source shall be either a natural source or a water storage.

Chlorides in firewater increase corrosion effects and aquatic organism can cause detrimental layer accumulation inside the firewater piping.

Water storage

Water in a Firewater storage tank shall be of high quality fresh water and free from water treatment chemicals that can be detrimental to foam generation. Water storage shall provide continuous 4 h supply with maximum design flow. Water storage shall be divided to two equally sized tanks to allow one tank to be temporarily out of service, when other full tank will provide 2 h supply with maximum firewater flow.

FW pumps

FW pumps shall provide maximum design flow even if the biggest pump is out of service i.e. 2 x 100% of maximum flow or 3 x 50% of maximum flow. Maximum flow shall be achieved even during total electrical black out.

In larger installations fire water pumps must be located in different safe locations to avoid common cause failure and reduce vulnerability.

13 FIRE WATER NETWORK REQUIREMENTS

Pipe sizing shall be based on required water flow rate and pressure demand at the most remote fire area under examination even if one of the fire water main supply routes is out of operation. Flow velocity shall not exceed 3.5 m/s.

Generally the network shall be buried at least 1 m depth (or 300 mm deeper than soil frost penetration limit) where it runs through high hazard areas and road crossing (with concrete housing at road crossing). For network piping running above ground at less hazardous areas, it must be sufficient protected to prevent any possible physical damage by vehicles.

The whole Fire water system must be protected from freezing. (where applicable)

Fire Water main shall not route under buildings or structures where it could cause damage in case of a pipe rupture and leak.

The fire water piping will be installed as a “looped” system, with strategically located, isolation valves. The installation of these valves will be based on the following criteria:

- No more than 60 meters of pipe supplying hydrants, monitors or hose reels shall be removed from service at one time for maintenance or repair.
- Failure of a single element of grid shall cause no more than three (3) fire protection device (monitors, hydrants, fixed spray system, not counting live hose reel) to be removed from service at a time. Required fire water flow to the area must be assured.

The isolation valve stem with post indicator shall be located above ground.

To avoid too big particles in firewater, that could cause damages or block equipment, screens shall be used before firewater pump suction sump in natural sources and strainers before any safety critical system or device that could become ineffective due to particle accumulation. Strainers shall be of type that can be flushed during operation and there shall be a bypass line connection around the strainer.

13.1 Fire Hydrants

The hydrants spacing shall not exceed 40 m.

The hydrants shall be at least 6” (150 mm) diameter with 2 x 2½” diameter connection. In high hazard areas bigger hydrant risers with 4 x 2½” and additional large diameter couplings (5") shall be used. Coupling type and size must be the type that local fire department and mutual aid organization use.

Where applicable, hydrants shall be equipped with a flange suitable for monitor connection

Hydrants shall be protected against any collision damage.

High capacity FW manifolds shall be located on strategic locations based on hazard assessments. Manifold riser shall be at least 10" in diameter and the manifold equipped with outlets capable to feed high capacity equipment.

13.2 Dry risers

Dry risers with outlets in every platform level shall be provided for each plant location where main equipment platforms are higher than 10 m elevation.

Connection straight to the firewater main shall be considered in specific locations based on operational experience and fire hazard assessments.

13.3 Fixed Water Monitors

The monitors shall be manually operated or remote controlled and suitable for adjustable straight/fog jet stream.

Between the monitor and equipment to be protected, obstacles or structures shall not be present.

A minimum distance of 15 m and maximum distance of 30 m from the protected equipment shall be provided.

Monitor water capacity shall be at least 4000 l/min at 7 barg of supply water pressure, the rotation angle shall be 360° and elevation angle shall be 80°. Their horizontal operating range, with straight jet, shall be 45 m minimum.

In terms of monitor range, a 30% reduction shall be considered compared to the value given by a manufacturer (water/foam streams are very prone to wind effects).

Based on hazard assessments, a monitor nozzle can be self eductor type for foam concentrate usage.

Auto-oscillating type monitor can be used with operating valve located at 15 m from the protected equipment.

When required by the Fire hazard Analysis, higher capacity monitors minimum 6000 l/min shall be used.

13.4 Elevated Fire Water Monitor

Remote controlled Firewater monitors shall be provided for elevated or otherwise not from the ground level reachable targets that are identified in fire hazard assessments. Required firewater flow and range shall be defined by the size of the scenario and equipment to protect.

Elevated monitor load bearing structure and devices shall be fire proofed.

13.5 Water Spray Fixed System

Each water spray system shall be activated by means of Deluge Valve, located at least at 15 m from the protected equipment.

The Deluge Valve shall be actuated automatically by dedicated Fire Alarm Control System or with remote control push button or manually by operator on field. Remote or manual activation point shall be located at least 15 m away from the edge of the protected equipment pool fire area. Cables and actuators for automatic deluge valves shall be fire proofed.

Strainers shall be provided upstream the valve in order to avoid plugging. Strainers shall be of type that can be flushed during operation and there shall be a by-pas line connection around the strainer.

Fixed water spray system shall be provided for the equipment listed in Chapter 6 or other necessary targets identified in FHA.

14 FIRE EXTINGUISHERS

The extinguishing agent may vary depending on the type of fire:

- Multipurpose polyvalent dry chemical powder for all type of fire (A B and C), in process units, storage area and utilities.
- CO2 in control room, electric substation, switchboard or computer rooms, laboratories, offices and social buildings.

Extinguishers are located in strategic places in well visible locations.

In process units, portable powder extinguishers shall be placed so that the travel distance from any part of the process area to the nearest extinguisher is less than 15 meters.

In addition wheeled powder extinguishers are supplied for compressor areas, pump alleys and pumping stations

Portable fire extinguisher will be provided and mounted for all buildings. Type of portable extinguisher will depend on building function.

Fire extinguisher type locations and marking will be according to local authority requirements.

Additional extinguishers shall be added based on hazard assessments.

15 CLEAN AGENT SYSTEMS

The system, total flooding type, shall be designed and installed in accordance with NFPA 2001, NFPA 12 and local code requirements.

The system consists of single shoot storage cylinder(s) rack calculated for the worst scenario (room that requires the maximum amount of clean agent), distribution piping, addressable type detection system and optical/acoustical alarm device located inside and outside protected area.

The system will be automatically activated by relevant high sensitivity smoke detectors.

Signal coming from one detector will initiate an alarm; signal coming from two detectors will initiate the fire suppression gas discharge (in case of automatically activated system).

A visual and audible Pre-activation alarm shall allow people to escape out of the room before discharge and Post-activation visual signal shall prevent access before room is confirmed to be safe.

16 FOAM SYSTEMS

Foam system role and performance criteria shall be based on fire scenarios identified in the Fire hazard Assessments.

Foam is suitable either for liquid pool fire extinguishment or preventing ignition by blanketing a pool with foam layer and hence suppress the release of flammable vapours to atmosphere.

Foam is not effective in pressurized three-dimensional fires.

Foam system performance requirements:

Functionality:

- Area of foam coverage
- Application method and application rate
- Foam concentrate compatibility with the fuels on site
- Foam concentrate compatibility with the whole foam system components and materials.
- Fire detection time
- Response time to full operation
- Duration of discharge to achieve full extinguishment

Availability:

- Automatic, remote controlled or manual activation
- Safe location of system activation

Reliability:

- The level of reliability depends on the criticality of the system
- Components quality and reliability
- Duplicate components
- Back up arrangements during out of service maintenance
- Provisions for ongoing tests during operation

Survivability:

- Resistance to heat radiation or direct flame impingement prior to activation.
- Consideration of the need for system components passive fire protection

16.1 Foam concentrate

Foam concentrate shall be suitable for fuels to be used at site and sufficiently tested and proven to have effective fire extinguishment performance. Foam concentrate must be compatible with the proportioner, materials and equipment that are used as whole in storage and deployment of the foam. Environmental effects of the foam concentrate shall be studied and possible foreseeing restrictions shall be taken in account. (More information in the corporate standard: Responsible Fire Fighting foam management). Neste Foam Concentrate Purchase Specification shall be used and Corporate Fire Safety Specialist shall be consulted before a purchase of a foam concentrate.

16.2 Foam storage

- Wherever possible keep concentrate in original containers.
- When a system require a foam concentrate tank, the material shall be completely inert to reaction with the concentrate. Materials such as High Density, Cross Linked Polyethylene or Polypropylene have proved very suitable for most foam concentrate types but it is still critical to ensure compatibility.
- Black steel tanks or linings inside are not suitable for foam concentrate storage
- Storage vessels shall not be exposed to direct sunlight
- Air contact with stored concentrate shall be minimized by means of pressure/vacuum vent and expansion domes.

Total storage capacity of foam at site shall be 200 % of the worst scenario demand (i.e. 100% spare volume).

16.3 Foam pumps and proportioners

Foam pump and proportioner functionality and materials shall be compatible with the foam concentrate. Especially the viscosity of the foam concentrate shall be taken into account to ensure reliable concentrate proportion to the water flow.

Bladder tank systems is not recommended for foam storage and proportion.

Balanced pressured (water driven) proportioner is a required for systems that have wide flow range in different operation conditions.

Inline inductors can be used when only one fixed flow foam device is used at time , e.g. hand held devices or monitors.

Also self-educing nozzles can be used for monitor application.

16.4 Foam solution pipework and foam nozzles

Corrosion resistant materials or finishes shall be used where it may be subjected to corrosive atmospheres. Normally empty pipework shall be hot dip galvanized steel as a minimum, however, piping for foam concentrate, or in continuous contact with foam solution, shall not be galvanized and shall be compatible with the foam concentrate used.

Foam disharge nozzles can be aspirated or semi-aspirated type. Foam discharge shall be designed to provide a gentle foam application to the fuel surface. Some foam types requires fully aspirated nozzles to create a firm foam blanket.

16.5 Foam application methods and rates

Application methods:

Fixed (manually or remote controlled) foam monitors shall be preferred in potential flammable liquid pool areas. Fixed system consists of fixed water supply, foam concentrate container, proportioning system and a (remote controlled) monitor nozzle.

If the pool fire area is not reachable by monitor application, a fixed foam pourer application method shall be used: Fixed system consists of fixed water supply, foam concentrate container, proportioning system and foam solution pipework to the outlets or spray nozzles.

Portable foam monitors and hose lines shall be available for supplementary foam application and for foam blanketing for ignition prevention.

Whichever application method is used, it is important to provide a gentle foam application to the fuel surface without splashing or plunging the foam.

Application rates for process area pool fires

Monitor application rate and duration for pool fires:

- The minimum application rate is 6,5 l/min/m2 on the fuel surface. Potential losses shall be considered, such as foam drop out, carried by the wind, thermal updraft and obstacles that restrict the foam flow.
- Fixed foam discharge nozzles application rate: 5 l/min/m2
- Minimum discharge time for both options : 20 minutes

Application rates for Storage tanks and Bunds

Higher application rates and discharge times are needed in fuel in depth situations than in shallow spill fires. Basic design figures are described below and EN-13565-2 shall be followed for more detailed requirements.

Monitor application: 11 l/min/m2 for 60 minutes discharge time

Fixed foam pourers: 5 l/min/m2 for 60 minutes discharge time

17 Performance measuring, evaluation / verification and reporting

Fire Hazard Analysis for each process unit shall be performed at maximum 5 year interval as defined in PHA standard. Active fire protection system adequacy against this shall be evaluated in FHA and possible corrective actions defined.

Regular audits shall be performed.

Audits during Investments projects

Active fire protection performance requirements defined and updated in the equipment documentation.

18 Definitions

Application Rate: The rate at which foam solution is applied to a fire, expressed as litres per minute, per square meter (l/min/m^2)

Deluge System: A water based fire protection system in which the application rate of water generally exceeds 10 mm/minute/m^2. Water may be used to control or extinguish fire, or provide cooling to fire exposures. A deluge system will usually use 'open' heads and will include a deluge valve specifically designed for the purpose. Water will be discharged over the entire area of operation.

Drainage Time: A measure of the rate at which water drains from foam. A high drainage time demonstrates foam's ability to maintain it's heat-resisting and stability properties.

Dry Powder (Dry Chemical in US): Powder for smothering fires, particularly electrical and flammable liquid fires

Fire area: See Neste Lay-out Specification W103 and HSE Design Guidelines Standard

Fire Detection: Equipment used to warn of a fire by sensing fire phenomena such as heat, smoke, flame radiation or incipient combustion gases. Fire detection can give a local, remote or site-wide fire alarm.

Fire Systems Integrity Assurance: A structured approach aimed at ensuring the implementation of test, inspection and maintenance procedures for fire systems

Foam: A stable aggregation of small bubbles, whose properties are such that it may be used as a flame-smothering blanket, or to prevent the entry of air, or to suppress vapour

Foam Concentrate: A concentrate liquid foaming agent, which is the basis from which foam is generated

Foam Quality: Foam parameters such as expansion and drainage time which, when measured, can give an indication of foam's properties such as flowability and heat resistance

Gas detector: An instrument, fixed or portable, designed to detect and measure the presence and concentration of flammable gas in an area

Gaseous Agent: Carbon Dioxide (CO_2), "Chemical" Halon replacements and other proprietary inert gases used for the purposes of extinguishing fires. (e.g. in areas such as turbine enclosures) They work either by reducing oxygen concentration to a point below which combustion cannot be supported, by terminating combustion reactions, or a by combination of both mechanisms.

Gaseous System: A fixed fire protection system using a *gaseous agent*

Mobile Firefighting Equipment: Fire fighting equipment generally larger than *portable fire fighting equipment* but which is nevertheless designed for effective deployment by small numbers of fire response personnel at a fire incident. (e.g. a mobile foam unit or medium sized *monitor*)

Monitor: A portable, mobile or fixed "cannon" designed to project water, foam, or both, for fire protection purposes

Portable Firefighting Equipment: Fire fighting equipment designed for simple, effective operation by one or two persons such as a fire extinguisher, portable *monitor,* foam hand line etc. See *mobile firefighting equipment*

Sprinkler System: Fixed multiple nozzle spray systems to enable water to be applied, for either cooling purposes or fire containment. They may be fitted with automatic activation systems

Water Mist System: A fire protection system producing very fine water droplets – most fewer than 400 microns in diameter. Water mist systems control and extinguish fires by wetting combustible substances, cooling, and to a certain extent, excluding oxygen. Minimal amounts of water are used in this type of system, but the systems needs to be highly engineered to be effective.

Water Spray System: A fire protection system consisting of fixed nozzles (designed to discharge water over petroleum plant or equipment) for the purposes of cooling against thermal flux, or, in some cases, for fire control.

19 Related documents

OGP, International Association of Oil and Gas producers: Fire Systems Integrity Assurance

EN 13565-2: Fixed firefighting systems – Foam systems – Part 2: Design, construction and maintenance

API

API RP 2001: Fire Protection in Refineries

API RP 2030: Application of fixed water spray systems for fire protection in the petroleum and petrochemical industries

NFPA

NFPA 10: Portable fire extinguishers

NFPA 11: Low, medium and high expansion foam

NFPA 12: Carbon dioxide extinguishing systems

NFPA 13: Sprinkler systems

NFPA 15: Water spray systems

NFPA 16: Foam/water sprinkler systems

NFPA 17: Dry chemical extinguishing systems

NFPA 20: Centrifugal fire pumps

NFPA 22: Water tanks for private fire protection

NFPA 24: Installation of private fire service mains and their appurtenances

NFPA 25: Inspection, testing and maintenance of water based fire protection systems