

# Tank Fire Suppression Strategy

Neste Oil, Porvoo Refinery

NESTE OIL

refining the future

# Kilpilahti industrial area in Porvoo, Finland



# Kilpilahti industrial area

- the largest concentration of chemical industries in the Nordic countries
- area 1,300 hectares
- provides regular employment for about 3,500 people, several hundreds service providers
- Neste Oil is the largest employer
- other companies:  
Aga, Ashland Finland, Borealis Polymers, Innogas, M-I Finland, StyroChem Finland, VR-Cargo.



# Kilpilahti industrial area

Seven other operators addition to Neste Oil:

- Borealis polymers: petrochemicals, pp-/pe-plastics
- Ashland: polyester resins
- Styrochem Finland: EPS
- Innogas: bottling of LPG
- Aga: nitrogen, oxygen, LNG
- VR-Cargo: railway terminal operations
- M-I Finland: oil production chemicals



# Neste Oil Porvoo Refinery

The Porvoo refinery focuses on high-quality cleaner traffic fuels

- Porvoo is a complex refinery with a versatile cracking capacity that enables a wide production range and improves the refining margin
- refining capacity is approximately 200,000 barrels per day
- constitutes four production lines; a fourth line, which is a diesel production line, came on stream on the first half of 2007
- the production lines constitute more than 40 process units
- NExBTL-diesel plant was completed at the refinery in 2007 and have a capacity of 170,000 tons/year, the capacity will be doubled in 2009 when the second unit will be started up
- the main feedstock is Russian crude



# Neste Oil Industrial Fire Brigade

- Agreement of unified fire and rescue services between the eight companies at Kilpilahti industrial area
- Mutual aid agreement with regional FRS in Porvoo (approx 15 min. away)



# Neste Oil Industrial Fire Brigade

- Full-time Fire Brigade
- 1 minute alert time 24/7
- 6 minute operational response time to the farthestmost location
- Four shifts, working on 24 hour periods
- 1+7 occupational fire fighters on shift.
- Approx. 70 part-time fire fighters on site supporting the full-time fire brigade



# Neste Oil Industrial Fire Brigade

Fire Engines	Pump capacity	Monitors	Foaming agent	Water
N11	6000 l/min	2x2400 l/min	4000 l multipurpose	4000 l
N12	6000 l/min	2x2400 l/min	8000 l multipurpose	4000 l
N16	10 000 l/min	2x2400 l/min Hydraulic boom, 23m: 5000 l/min	6800 l multipurpose	none
N21	6000 l/min	2x2400 l/min	2500 l multipurpose	2100 l
N31	6000 l/min	2x2400 l/min	2800 l multipurpose	2500 l
N32	6000 l/min	2x2400 l/min	6900 l multipurpose	



# Neste Oil Industrial Fire Brigade

Special equipment	Description	Characteristic
N191	Ambulance	Medical care equipment also for chemical injuries
N24	Powder and CO2 unit	Powder: 3000 kg CO2(pressurized): 315 kg
N241	CO2 unit for semifixed CO2 systems	CO2(refridge.): 7500 kg
Masterstream 4000	Trailer mounted high capacity monitor	18 000 lpm
	Fi-Fi Class A high capacity package	20 000 lpm
Portable foaming equipments	Bund pourers and monitors	Bund pourersx3: Monitors 2 x 6000 lpm

# Neste Oil Industrial Fire Brigade

Containers	Description	Characteristic
Rescue container	Hazardous materials incidents and rescue operations	Hazardous spill restriction and recovery equipments. Lifting,extricating and supporting tools
Oil spill response container 1	Oil spill prevention and response	Oil recovery equipments
Oil spill response container 2	Oil spill prevention and response	Surface oil dispersal boom
Foam container 1	Mobile foam stock	8500 l multipurpose foam
Foam container 2	Mobile foam stock	10 000 l multipurpose foam



# The Last Fire?

Tank Fire in 1989. Porvoo, Finland  
Product: Isohexane

- Partially sunken roof – foaming – ignition when adding foam
- Extinguished in 50 minutes.  
Application rate: 7 lpm/m<sup>2</sup>
- Second ignition after 30 minutes.
- Foam attack – one foam tender failed – insufficient application rate - change to the “Burn Down” strategy after 15 minutes attempt
- The Fire lasted for 32 hours

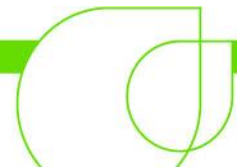


# The Last Fire

- We don't like to experience a 32 hours tank fire again
- To prevent a tank fire ever happen again is the best option
- Still we have to develop a strategy for managing a tank fire



# The Planning Process



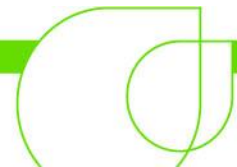
# Facility survey

- Over 150 hundred storage tanks
- All the tanks are either cone roof or IFR tanks
- Tank sizes varies between 10m to 52m in diameter
- Semi-fixed foam systems: Top pourers, sub surface and semi sub surface
- Readiness for over the top application
- Fire water capacity exceeds 50 000 lpm (Sea water)



# Tank Fire Suppression Philosophy

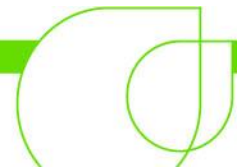
- We shall minimize the effects of a tank fire to the people, environment and to the business with cost effective use of all resources available.
- The first option is a quick extinguishment with a semi-fixed system
- We shall prepare for extinguishing a full surface fire of our largest tank even if the semi-fixed system fails



# Developing the tactics

## APPLICATION RATES

- NFPA 11,  
API RP2021: 6,5 lpm/m<sup>2</sup> + “potential foam losses”
- Energy Institute IP19,  
LASTFIRE RRO: 6,5 lpm/m<sup>2</sup> + 60% = 10,4 lpm/m<sup>2</sup>
- En 13565-2: 10-12 lpm/m<sup>2</sup> (depending on the tank diameter)



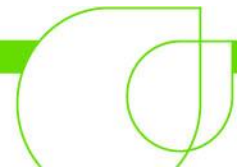


# Developing the tactics

APPLICATION TIME:

NFPA 11: Minimum application time 55-65 min...

**FOR PUTTING THE FIRE OUT!**



# Developing the tactics

A lesson learned in house:

To first extinguish a tank fire and then let it burn down for 32 hours..

**IS NOT A VERY COST EFFECTIVE WAY!**



# Developing the tactics

- Before initiating the foam attack, additional resources for securing the foam blanket post extinguishment shall be in place

Energy Institute IP 19

API RP2001

LASTFIRE RRO

EN 13565-2

Different sources recommend to add 50-100% for a total amount of foam concentrate required for extinguishment....

**TO KEEP THE FIRE OUT!**



# The selected basics for extinguishment

- Semi-fixed system as the first option
- Over the top application when all the resources in place
- Application rates:
  - 5 lpm/m<sup>2</sup> for semi-fixed system
  - 11 lpm/m<sup>2</sup> for monitor application
- Application time 90 minutes
- More rapid and successful extinguishment with extensive application rates



# The selected basics for cooling

- Do not cool the burning tank, except in the final phase of the extinguishment to help the foam to seal against the tank shell
- Cooling of adjacent tank is necessary only if the cooling water vaporizes off the tank shell
- Generally cooling is not necessary if the semi-fixed system has timely been activated



# Tank Fire Suppression Strategy

Three integrated stages of response:

**1a** All the tanks using semi-fixed foam systems

**1b** Small tanks up to 25m in diameter; over the top

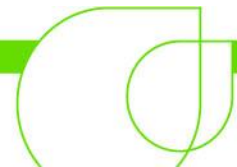
**2** Middle size tanks from 26 to 42 in diameter; over the top.

**3** Large tanks up to 52 in diameter; over the top.



# 1a Tank fire suppression using semi fixed foam systems

- **1st response:** N11, N12, N16, N31, N 32
- Implementation time frame < 1 hour
- Total foam concentrate on board 28 500 l
  
- N12, N32 connected to the semi fixed system
  - The largest tank 52m in diameter, 2123 m<sup>2</sup>
  - Application rate 5 l/min/m<sup>2</sup>
  - 90 minutes application time: 28600 liters of foam required
  
- Supplementary foaming with N16 hydraulic boom



# 1b Small tanks up to 25 in diameter; over the top application

- Application rate 11 lpm/m<sup>2</sup>
  - 25m tank: 5397 lpm
  - Duration 90 minutes
  - Total foam concentrate required:  
**14 571 liters**
- 
- **1st response:** N11, N12, N16, N31, N 32
  - N16: Hydraulic boom, monitor 5000 l/min
  - **Implementation time frame < 1 hour**
  - **Total foam concentrate in place: 28 500 l**





## 2. Medium size tanks between 26 to 42 in diameter

- Application rate 11 lpm/m<sup>2</sup>
  - 42m tank: 15 232 lpm
  - Duration 90 minutes
  - **Total foam concentrate required: 41 127 l**
- **1st response:**
- N11, N12, N16, N31, N32
- + **2nd response:**
- High capacity monitor 18 000 l/min
  - Foam container 1: 8500 l
  - Foam container 2: 10 000 l
- **Implementation time frame < 2 hours**
- **Total foam concentrate in place: 47 000 l**



### 3. Large tanks up to 52 meter in diameter

- Application rate 11 lpm/m<sup>2</sup>
  - 52m tank: 23 349 lpm
  - Duration 90 minutes
  - **Total foam required: 63 042 l**
- 
- **1st response:**
    - N11, N12, N16, N31, N32
  - **2nd response:**
    - High capacity monitor, Foam1, Foam2
  - + **3rd response:**
    - Portable foam monitors 2 x 6000 lpm
    - Regional FRS: 3 x 10 000 l of foam
    - **Total monitor attack capacity: 30 000 lpm**
    - N16 for supplementary foaming
    - **Implementation time frame < 3 hours**
    - **Total foam concentrate in place: 77 000 l**



**Thank you**

**refining the future**

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**The plan is nothing,  
planning is everything**