Fire-Water System Problem Using Fluidflow



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1. ABSTRACT:

Fire-water supply system is simulated in this paper. This study is based on real system. ABC Corp. has a production facility containing slug catcher vessel, separators, compressors, hydrocarbon pumps, shell & tube heat exchangers and air fin coolers.

Fire water supply system consists of Fire water storage tanks, 2 nos. pumps (1 duty + 1 standby), jockey pumps (1 duty + 1 standby), piping network, deluge valves and sprinklers.

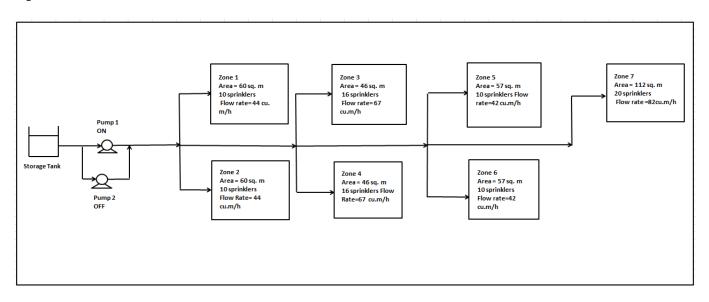
Total area of 450 m² is to be provided with fire water sprinklers. A total of 92 sprinklers are required. Demand flow rate of each zone has been calculated. 20% excess flow rate margin has been considered as safety margin.

This system has been simulated using Fluid Flow software. Using simulation, the following results have been obtained:

- Required flow rate through the pump
- pump head
- flow rate through each zone
- flow rate through each sprinkler
- Pressure upstream of each sprinkler
- Line sizes

Schematic Diagram:

Figure 1:



FluidFlow software has been used to carry out Fire-Water system simulation.

2. PROCESS DESIGN BASIS

Table-1 consists of various zones, equipment, no. of sprinklers in each zone, demand flow rate, area of each zone and flow rate.

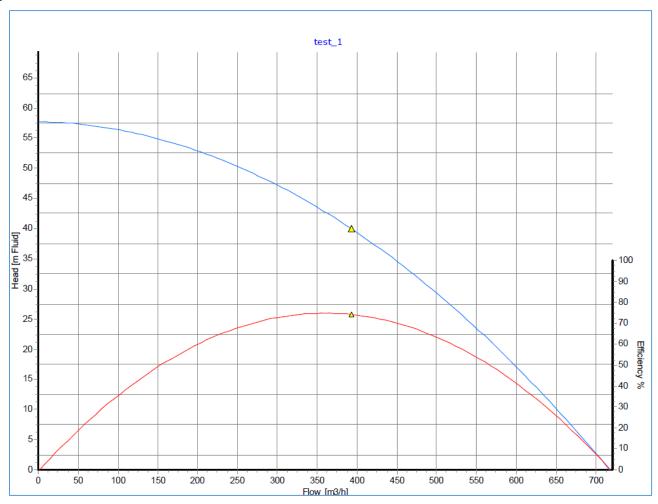
Table 1:

Zone	Equipment	No. of	Demand Flow Rate	Area	Flow Rate	Flow Rate
		sprinklers	(LPM /m ²)	(m^2)	(m ³ /h)	(20% excess) (m ³ /h)
1	Slug Catcher Vessel	10	10.2	60	36.72	44.06
2	Pressure Vessel	10	10.2	60	36.72	44.06
3	Compressors	16	20.4	46	56.304	67.56
4	Hydrocarbon Pumps	16	20.4	46	56.304	67.56
5	Shell and Tube Heat Exchangers	10	10.2	57	34.88	41.86
6	Air Fin Coolers and Support	10	10.2	57	34.88	41.86
7	Production Area	20	10.2	112	68.54	82.25

Pipe sizes are selected as per velocity criteria provided in API 14E. Typical velocities for centrifugal pump considered are 1 m/s for suction line and 2.7 m/s for discharge line.

Test_1 pump model has been used with pump curve data as given below.

Figure 2:



FluidFlow simulation software is used for pipe hydraulic calculation. Pipe MOC considered is steel pipe. Hazen-Williams equation is used for pressure drop calculations. C factor of 150 is considered.

3. PROCESS SIMULATION STUDY

Fire-Water system has been studied. The storage tank is at 1m elevation. 399 m^3/h is pumped from storage tank to seven fire zones. The sprinklers chosen are of type SIN C1111-A-UP (K=2.8).

This case is simulated and the model snapshot with results are provided in Attachment 1.

4. RESULTS:

Simulation results are provided in Table 2.

Table 2:

Zone	Equipment	Required	Actual Flow	No. of	Flow Rate through each
		Flow Rate (m³/h)	Rate (m³/h)	Sprinklers	Sprinkler (m³/h)
1	Slug Catcher Vessel	44.06	44.8	10	4.5
2	Pressure Vessel	44.06	44.2	10	4.4
3	Compressors	67.56	68	16	4.2
4	Hydrocarbon Pumps	67.56	68	16	4.3
5	Shell and Tube Heat Exchangers	41.86	45.5	10	4.3
6	Air Fin Coolers and Support	41.86	42.9	10	4.3
7	Production Area	82.25	85	20	4.3

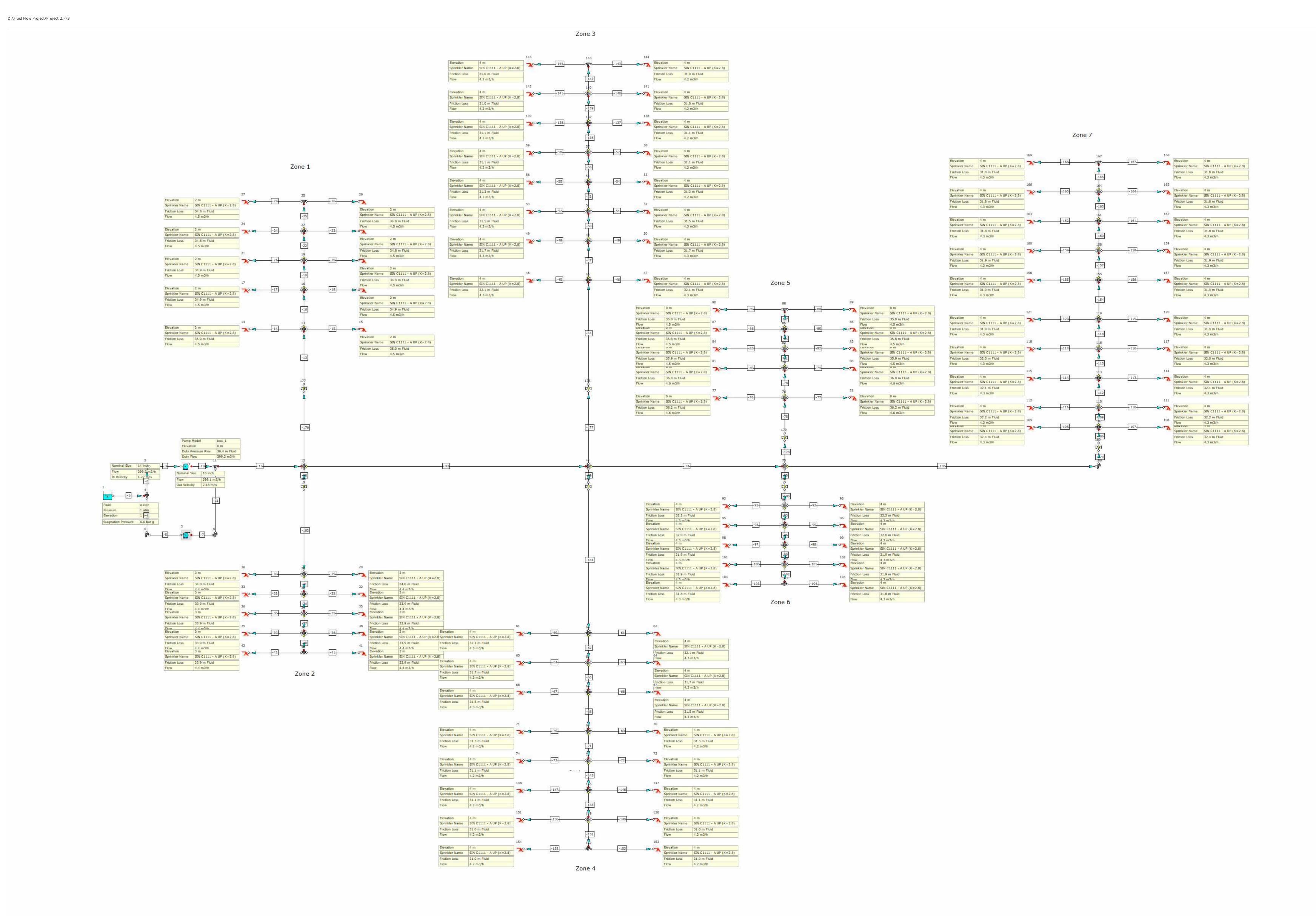
5. CONCLUSIONS

Following can be concluded as per this simulation:

- Pump flow rate is 399 m³/h and the pump head is 41 m water column.
- The pump operates at 75% efficiency.
- Line sizes of 1", 1.5", 3", 4", 10" and 12" are used.
- Around 4.3 m³/h of water flows through each sprinkler.
- Friction loss through each sprinkler is around 300 kPa.
- It is worth noting that *FluidFlow* software is extremely user-friendly and accurate.

6. ATTACHMENTS

• Attachment : Fire-Water System model snapshot and results



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