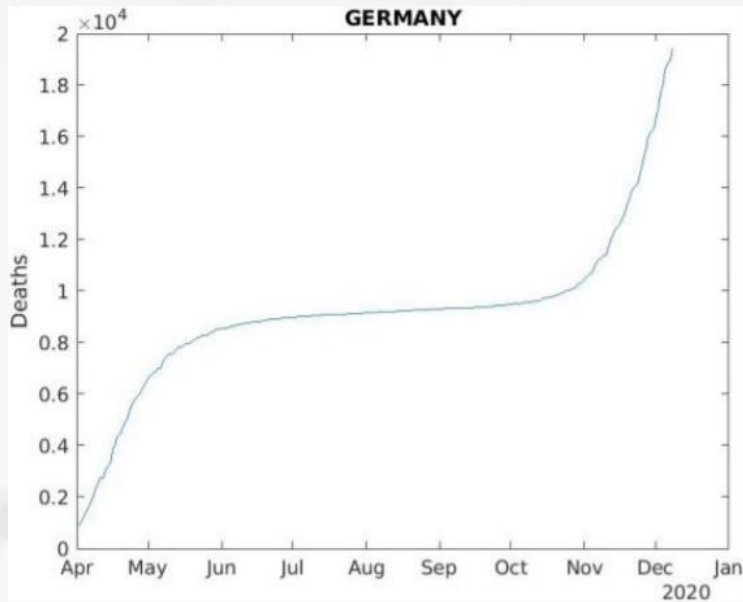
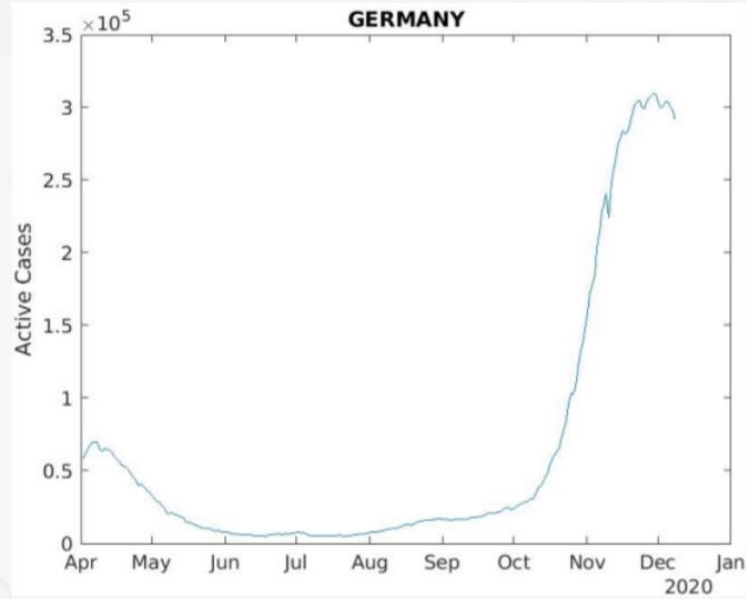


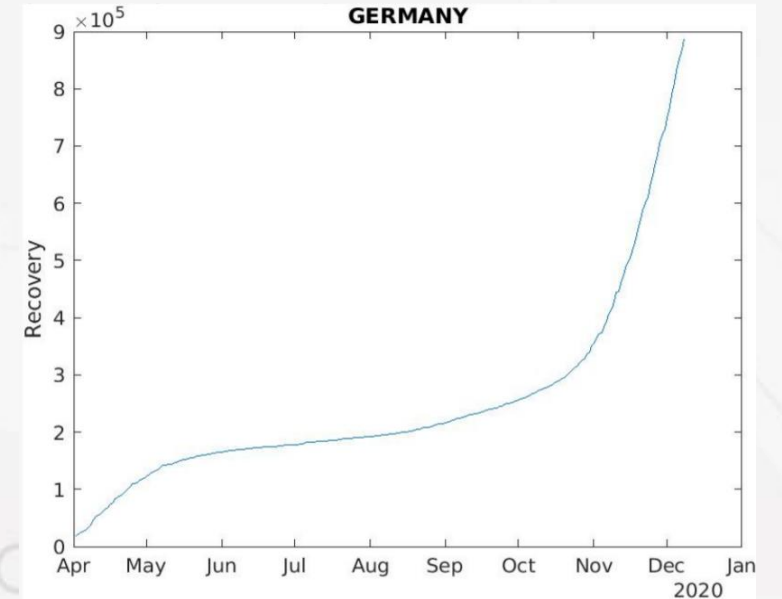
Assignment Part A : Time Series Plot



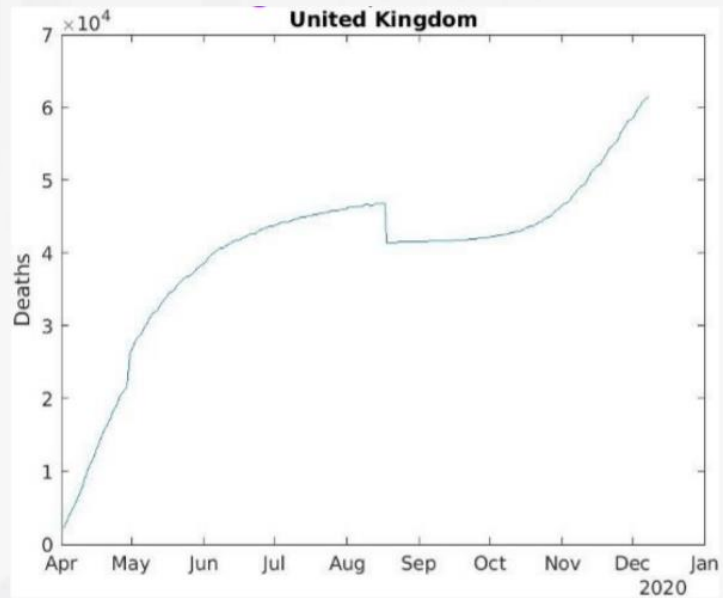
```
plot(Covid_GER.Last_Update,Covid_GER.sum_max_Deaths);  
ylabel('Deaths');title('GERMANY')
```



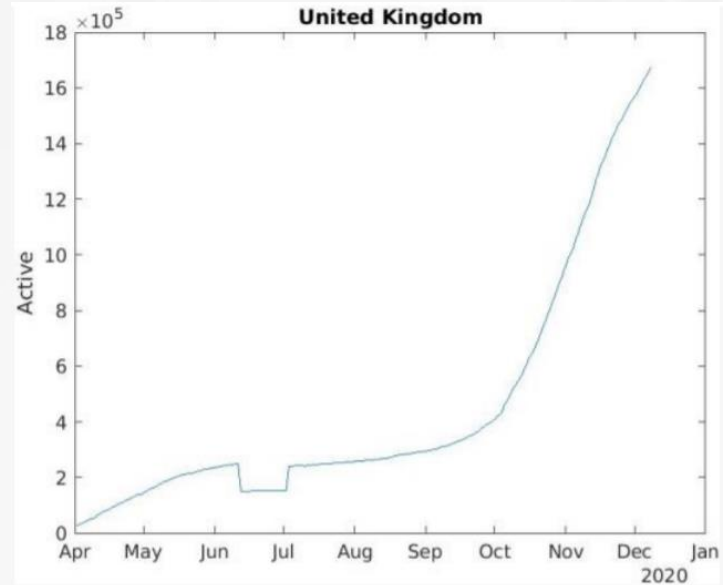
```
plot(Covid_GER.Last_Update,Covid_GER.sum_max_Active)  
ylabel('Active cases');title('GERMANY')
```



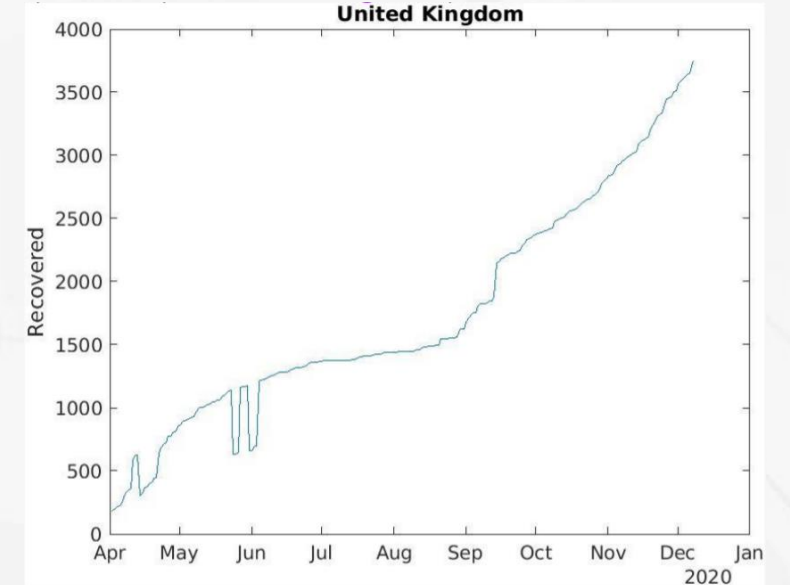
```
plot(Covid_GER.Last_Update,Covid_GER.sum_max_Recovered)  
ylabel('Recovered');title('GERMANY')
```



```
plot(Covid_UnK.Last_Update,Covid_UnK.sum_max_Deaths);  
ylabel('Deaths');title('United Kingdom')
```

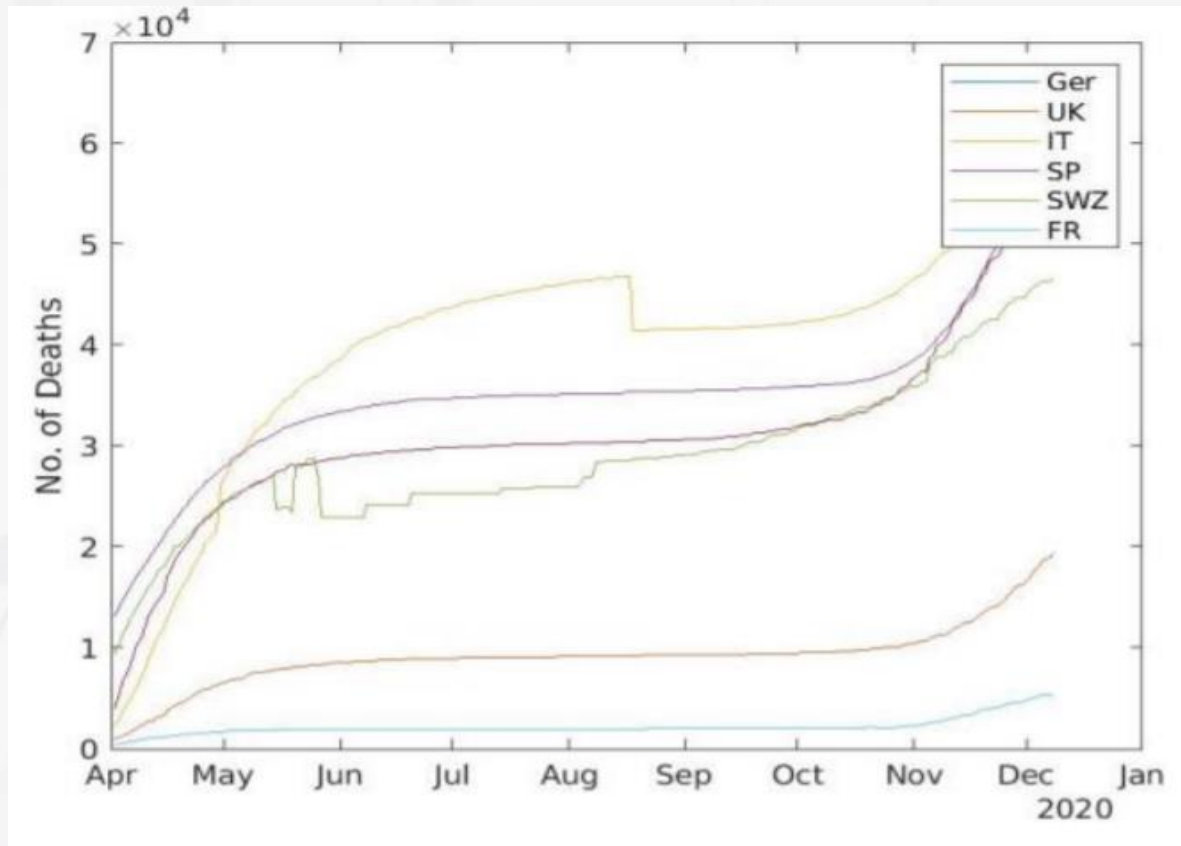


```
plot(Covid_UnK.Last_Update,Covid_UnK.sum_max_Active)  
ylabel('Active cases');title('United Kingdom')
```



```
plot(Covid_UnK.Last_Update,Covid_UnK.sum_max_Recovered)  
ylabel('Recovered');title('United Kingdom')
```

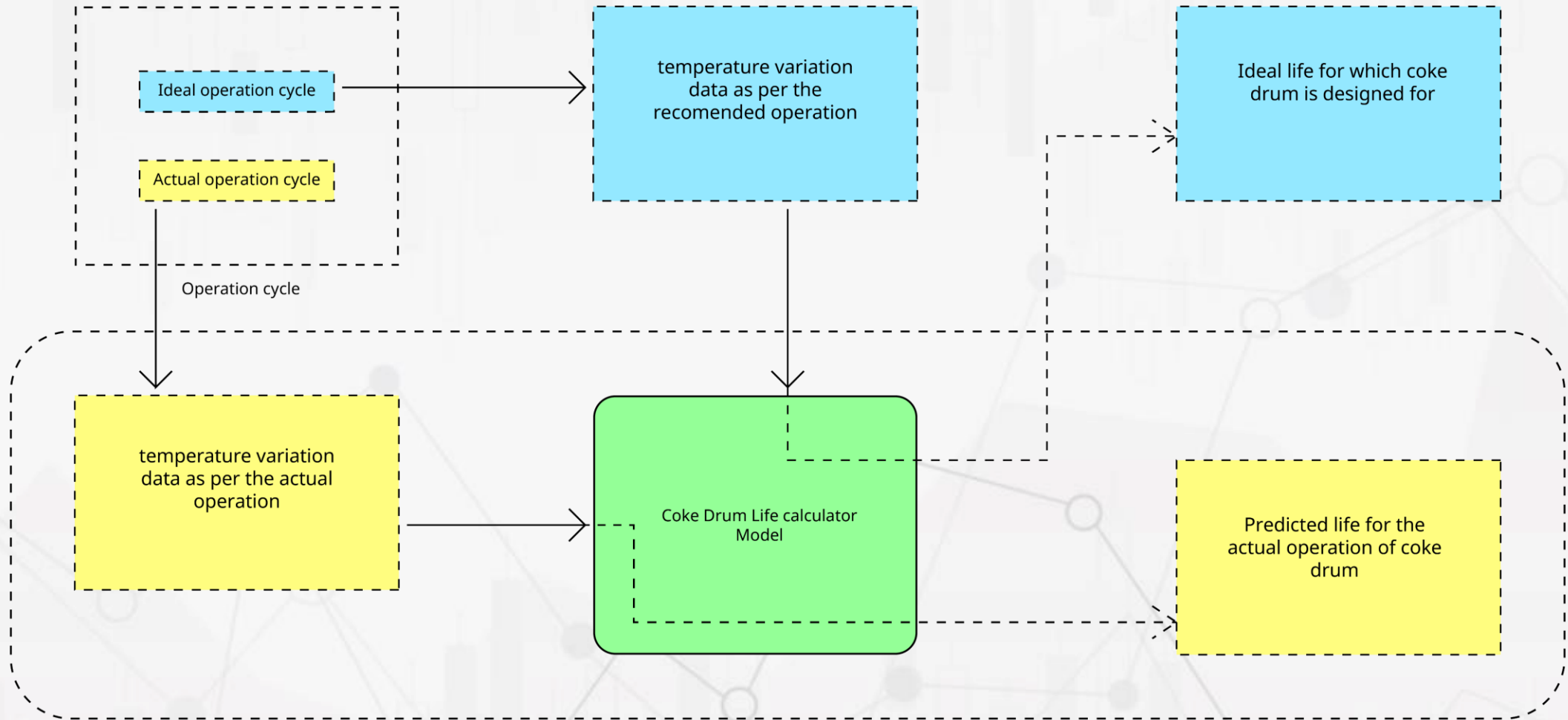
Combined plots for European Countries



```
plot(Covid_GER.Last_Update,Covid_GER.sum_max_Deaths);ylabel('No. of Deaths');legend('show');legend('Ger'); hold on;
plot(Covid_UnK.Last_Update,Covid_UnK.sum_max_Deaths);ylabel('No. of Deaths');
plot(Covid_ITY.Last_Update,Covid_ITY.sum_max_Deaths);ylabel('No. of Deaths');
plot(Covid_SPN.Last_Update,Covid_SPN.sum_max_Deaths);ylabel('No. of Deaths');
plot(Covid_SWZ.Last_Update,Covid_SWZ.sum_max_Deaths);ylabel('No. of Deaths');
plot(Covid_FRA.Last_Update,Covid_FRA.sum_max_Deaths);ylabel('No. of Deaths');
legend('show');legend('Ger','UK','IT','SP','SWZ','FR');
```

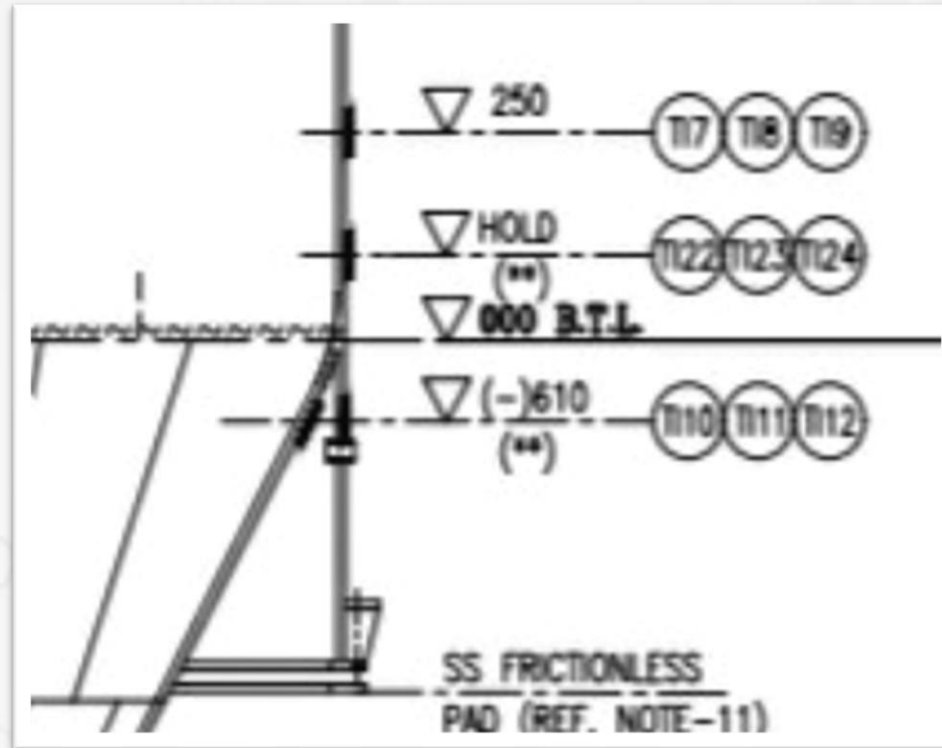
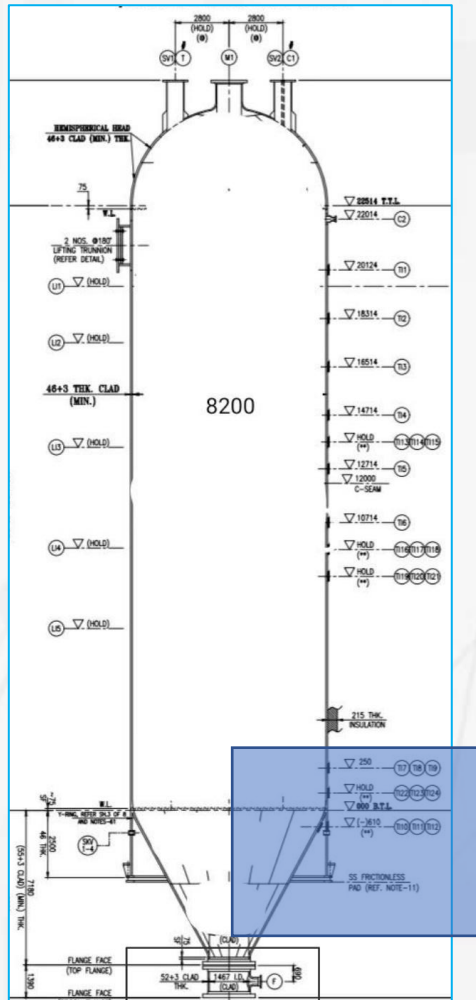
As the graph gets steeper from Nov 2020, it becomes evident that the COVID-19 cases are increasing again as a second wave

Assignment Part B : Project Schema



Presently missing model in the Industry – Scope of the project

Assignment Part B : Source of Data



Surface Thermocouple Sensors

Based on Process/Inspection Monitoring Requirement, multiple skin thermocouples are installed on drums at different locations along the axial length.

For this Project Thermocouple data at support skirt-cone-shell junction is considered.

These sensors provide the temperature data at regular intervals which is the main predictor variable in this project.

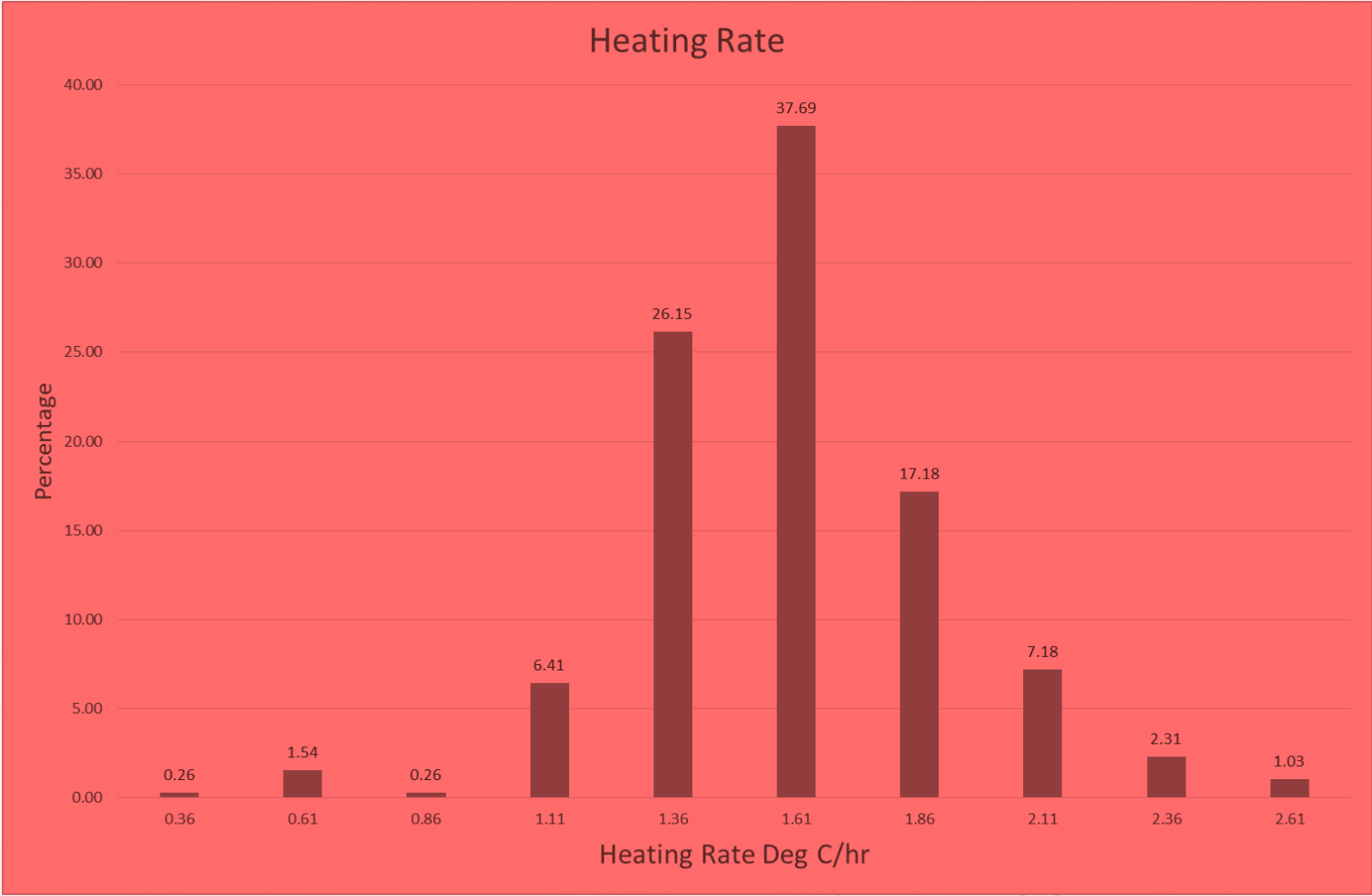
Assignment Part B : Data Schema

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
1		TC.604TI2460	TC.604TI2461	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462	TC.604TI2462
2	01-09-2020 00:00	414.15	417.55	398.89	401.02	417.28	398.46	802.9	420.68	408.22	411.69	402.56	328.48	405.95	400.32	401.98	352.71	342.78	311.11	313.92	300.38
3	01-09-2020 00:01	413.99	417.58	398.98	401.14	417.33	401.27	802.9	420.73	408.27	411.69	402.61	328.29	406	400.34	401.95	352.66	342.74	310.96	313.97	300.36
4	01-09-2020 00:02	414.06	417.53	399.09	401.29	417.41	399.97	802.9	420.81	408.34	411.69	402.63	328.37	406.03	400.32	401.85	352.58	342.59	310.83	313.97	300.28
5	01-09-2020 00:03	414.15	417.6	399.16	401.4	417.48	401.7	802.9	420.88	408.42	411.69	402.58	327.85	406.03	400.34	401.8	352.56	342.49	311.1	314.07	300.5
6	01-09-2020 00:04	414.15	417.85	399.19	401.47	417.56	403.46	802.9	421.01	408.4	411.69	402.56	327.07	406.03	400.27	401.7	352.56	342.51	311.16	314.27	300.58
7	01-09-2020 00:05	414.3	417.95	399.24	401.6	417.58	401.72	802.9	421.06	408.27	411.74	402.56	326.61	406.08	400.31	401.5	352.51	342.49	310.86	314.25	300.41
8	01-09-2020 00:06	414.39	418.05	399.31	401.7	417.63	404.08	802.9	421.11	408.27	411.77	402.56	326.26	406.11	400.46	401.37	352.43	342.46	310.83	314.29	300.33
9	01-09-2020 00:07	414.39	418.2	399.39	401.82	417.71	402.34	802.9	421.13	408.34	411.77	402.56	326.08	406.06	400.57	401.4	352.41	342.51	311.13	314.45	300.57
143982	09-12-2020 23:40	405.92	418.59	380.79	802.9	392.33	389.55	802.9	398.52	382.06	418.46	409.38	347.76	419.07	412.9	423.17	355.69	349.94	321.65	321.35	317.55
143983	09-12-2020 23:41	406.57	419.15	381.11	802.9	392.63	390.09	802.9	398.83	382.36	418.59	409.48	347.41	419.19	413.08	423.4	355.95	350.32	322.2	321.7	317.86
143984	09-12-2020 23:42	406.98	419.31	381.54	802.9	392.93	390.64	802.9	399.18	382.61	418.69	409.6	346.88	419.34	413.28	423.57	356.22	350.74	322.75	322.05	317.99
143985	09-12-2020 23:43	407.06	419.31	382.09	802.9	393.24	391.19	802.9	399.46	382.89	418.82	409.7	346.18	419.5	413.5	423.72	356.47	351.05	323.18	322.33	318.29
143986	09-12-2020 23:44	407.22	419.36	382.64	802.9	393.59	391.67	802.9	399.73	383.14	418.97	409.78	345.42	419.6	413.83	423.88	356.75	351.32	323.61	322.75	319.01
143987	09-12-2020 23:45	407.46	419.43	383.17	802.9	393.92	392.13	802.9	400.03	383.37	419.07	409.86	344.42	419.67	414.25	424.03	357.05	351.67	323.92	322.94	318.93
143988	09-12-2020 23:46	407.71	419.65	383.7	802.9	394.27	392.43	802.9	400.34	383.55	419.19	409.93	343.54	419.75	414.56	424.08	357.25	352	324.24	323.14	319.45
143989	09-12-2020 23:47	407.95	419.76	384.18	802.9	394.6	392.76	802.9	400.69	383.8	419.3	410.01	342.78	419.73	414.74	424.18	357.5	352.25	324.67	323.39	320
143990	09-12-2020 23:48	408.19	419.86	384.63	802.9	394.95	393.13	802.9	401.02	384.05	419.37	410.03	342.07	419.85	414.89	424.28	357.75	352.53	325.02	323.66	320.17
143991	09-12-2020 23:49	408.44	420.4	385.08	802.9	395.28	393.51	802.9	401.32	384.28	419.5	410.13	341.39	419.93	415.04	424.31	357.98	352.78	325.37	324.06	320.76
143992	09-12-2020 23:50	409	421.05	385.48	802.9	395.53	393.94	802.9	401.62	384.5	419.6	410.23	340.57	419.98	415.19	424.4	358.3	353.06	325.7	324.47	320.91
143993	09-12-2020 23:51	409.41	421.46	385.81	802.9	395.85	394.34	802.9	401.92	384.78	419.67	410.31	339.42	420.05	415.44	424.56	358.73	353.31	325.85	324.94	321.07
143994	09-12-2020 23:52	409.34	421.52	386.02	802.9	396.18	394.72	802.9	402.17	385.03	419.8	410.38	338.13	420.22	415.74	424.61	359.28	353.68	325.93	325.37	321.01
143995	09-12-2020 23:53	409.57	421.34	386.12	802.9	396.53	395.05	802.9	402.45	385.26	419.95	410.41	336.9	420.45	415.95	424.66	359.98	354.13	326.2	325.8	321.1
143996	09-12-2020 23:54	410.05	421.36	386.14	802.9	396.86	395.35	802.9	402.75	385.48	420.05	410.51	335.79	420.68	416.15	424.73	360.64	354.49	326.38	326.15	321.35
143997	09-12-2020 23:55	410.54	421.56	386.29	802.9	397.11	395.7	802.9	403.01	385.66	420.18	410.61	334.93	420.9	416.32	424.81	361.24	354.79	326.5	326.45	321.43
143998	09-12-2020 23:56	410.71	421.49	386.52	802.9	397.34	395.93	802.9	403.28	385.91	420.33	410.73	334.47	421.13	416.43	424.88	361.79	355.09	326.7	326.75	321.58
143999	09-12-2020 23:57	410.71	421.27	386.84	802.9	397.62	396.23	802.9	403.58	386.11	420.43	410.84	334.26	421.36	416.6	424.96	362.32	355.44	326.88	327.2	321.81
144000	09-12-2020 23:58	410.55	420.94	387.17	802.9	397.87	396.46	802.9	403.84	386.32	420.55	410.96	334.01	421.58	416.73	425.03	362.95	355.77	327.08	327.58	321.93
144001	09-12-2020 23:59	410.31	420.71	387.47	802.9	398.1	396.61	802.9	404.11	386.54	420.7	411.06	333.91	421.76	416.85	425.11	363.48	356.02	327.21	327.79	322.4
144002	10-12-2020 00:00	410.38	420.76	387.77	802.9	398.42	396.81	802.9	404.41	386.82	420.85	411.19	334.01	421.96	416.95	425.19	363.83	356.3	327.43	328.08	322.59

Historian of Temperature data was recorded for every one-minute operations. From 1st of Sep 2020 to 10th of Dec 2020.

Ideally one complete cycle designed 48 hour ~ 2880 minutes. We have got 100 days of data, which means 50 complete cycle data to get processed.

First Cut Analysis : Heating



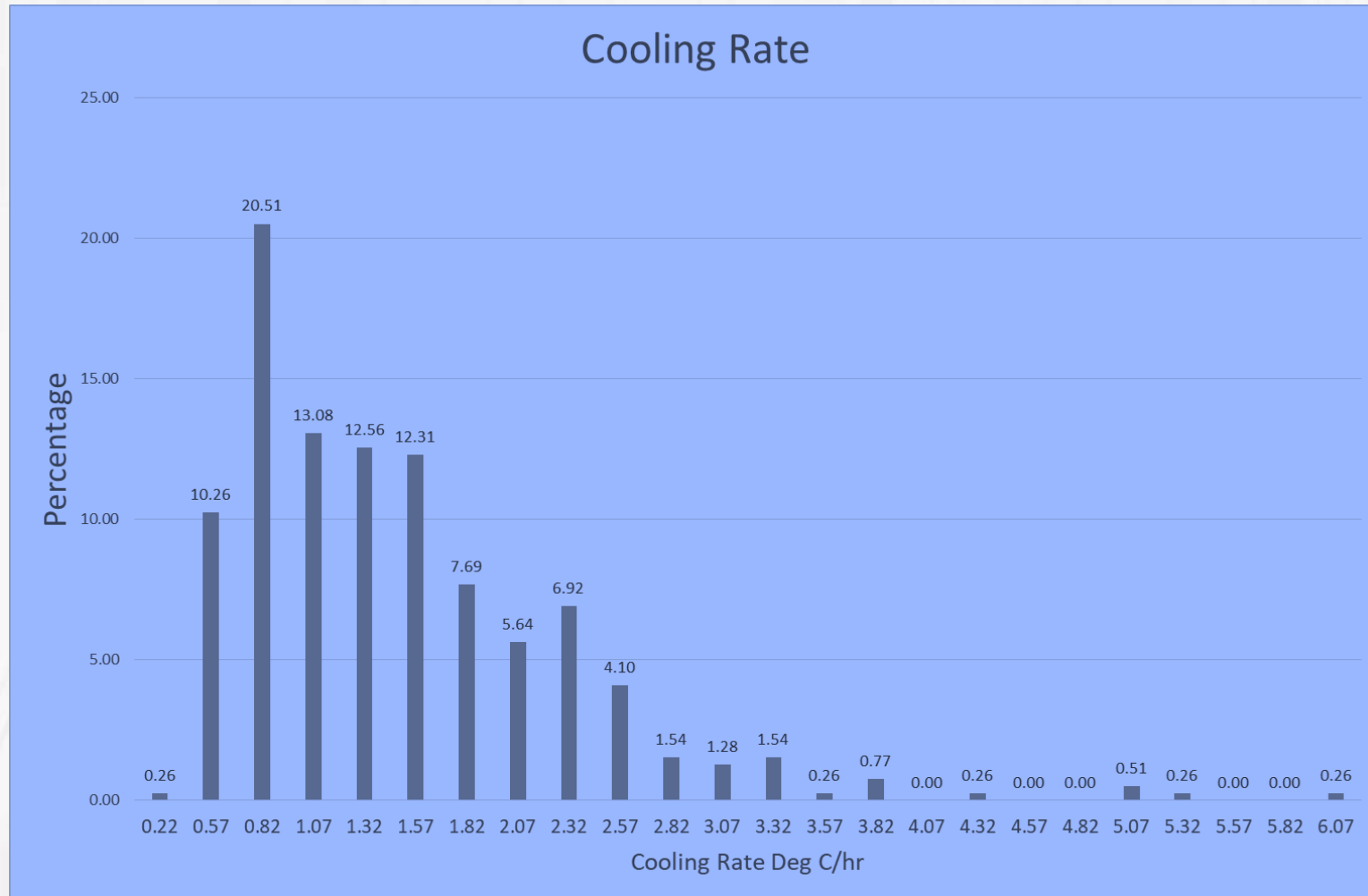
CYCLE	Heating Rate (°C/min)
IDEAL DESIRED PROCESS	3.0
SITE DATA	0.36 - 2.61
% of times within the Design Cycle Tolerance	100%

Higher the Heating Rate higher will the stress induced, resulting in reduced fatigue life.

Almost all data points are within Ideal Process Requirement.

There won't be any significant damage to the Designed Life of the Coke Drum

First Cut Analysis : Cooling



CYCLE	Cooling Rate (°C/min)
IDEAL DESIRED PROCESS	2.3
SITE DATA	0.22 - 6.03
% of times within the Design Cycle Tolerance	89.23%

Higher the Cooling Rate higher will the stress induced, resulting in reduced fatigue life.

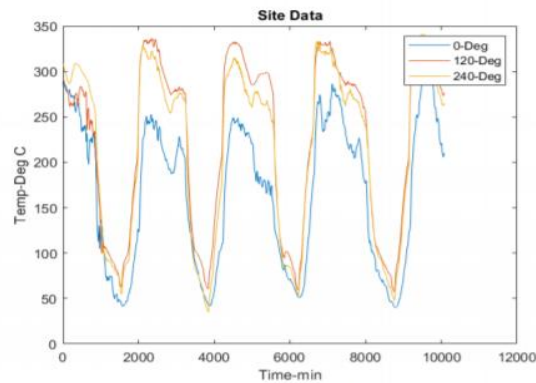
Almost 90% data points are within Ideal Process Requirement.

Still, on the conservative front, we have assumed 0.85 deg/min in the FEA to evaluate fatigue life.

Scripts

```
global abspath datapath scriptpath datasetspath;  
%path of the folder  
abspath='D:\dataProj\Proj';  
  
%path for the raw data from Jhudata  
datapath=strcat(abspath, '\sitedata\');  
  
%path where the scripts are kept  
scriptpath=strcat(abspath, '\scripts\');
```

```
%path where the results are kept  
datasetspath=strcat(abspath, '\datasets\');  
  
addpath(scriptpath);  
addpath(datapath);  
addpath(datasetspath);
```



The minute-wise data are easily extracted and plotted and visually compared using Matlab. Further the Data obtained has to be filtered and studied. Deg, Deg1 & Deg 2 are Thermocouple Probes.

```
plot(R1.Time_mins,R1.Deg);xlabel('Time-min');ylabel('Temp-Deg C');title('Site  
Data');  
hold on;  
plot(R1.Time_mins,R1.Deg1);xlabel('Time-min');ylabel('Temp-Deg C');title('Site  
Data');  
plot(R1.Time_mins,R1.Deg2);xlabel('Time-min');ylabel('Temp-Deg C');title('Site  
Data');  
hold off;legend('show');legend('0-Deg','120-Deg','240-Deg')
```