Titan™ Models of a Turbophase System

A Report Prepared for

PowerPHASE LLC

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Draft Report: Titan Models of a Turbophase System

1. Overview

PowerPHASE LLC engaged The Fidelis Group to create RAM (reliability, availability, maintainability) models of their Turbophase product using Fidelis' Titan discrete-event simulation software. The goal of this effort was to forecast availability of a Turbophase module (TPM) system in a configuration representative of anticipated operating configurations. The purpose of this report is to present the resulting forecasts and to document details of the models.

The initial work consisted of creating baseline models of a ten-TPM system. Subsequent simulations were run to study sensitivities of the forecast results to major changes in the RAM data used to populate the models.

Types of information included in these models are as follows:

- Equipment lists and configurations that define functional and reliability interrelationships
- Equipment capacities including turn-up and turn-down
- RAM data (Statistical characterizations of time-dependent equipment reliability performance including times between failures and durations of repairs)
- Spare parts counts and related off-line maintenance/repair durations
- Planned maintenance schedules, scope, and durations
- Impacts on production of failures of system components and/or subsystems.
- Operating rules, constraints, and schedules

Titan uses this information to perform discrete event simulations. Discrete event simulations are Monte-Carol based, time-dependent behavioral models of asset performance. Events in this context include planned outage start, planned outage end, unplanned outage start, unplanned outage end, removal of failed module (or component), repair of failed module (or component), replenishment of the spare module pool, and depletion of the spare module pool. On occurrence of each and every event, Titan recalculates the instantaneous output of the system and tracks this (and numerous other metrics) over time.

2. Results Summary

Table 1 shows results from eight different model runs, two runs per row. The first two runs (row 1) are baselines that utilize best-available RAM data. (Detailed discussions of input data are provided later in this report). The last three rows show results from applying RAM data value changes to assess sensitivity of results to those changes.

Effective availability values in the right-most two columns are the primary performance measures of interest. A separate run is required for different spares quantities, hence the two different availability values for each row. A discussion on the meaning of effective availability is provided at the end of this section.

In interpreting these results, readers should be mindful of several things:

- The Turbophase system is not critical to the nominal performance of the power plant(s) it feeds. I.e., TPM slowdowns or outages only lessen the incremental boost in total system output. They do not in any way curtail the power plant.
- The single spare cases assume the spare is a complete TPM "shelf spare" that would be swapped in to replace a failed TPM. A potentially attractive alternative (due to very minimal, incremental capital cost) would be to have the spare installed as a cold standby unit. Doing this would mitigate any penalty potentially imposed by module swap-time requirements and would therefore improve availability
- For reasons that will be discussed below, Fidelis believes the last two rows of sensitivity results are likely very conservative (i.e., pessimistic).

Table 1: Results Summary for Continuous Operation 10 TPM System

Run#	Case	MTBF Multiplier	MTTR Multiplier	Mean Effective Availability (%) Zero Spare Modules*	Mean Effective Availability (%) One Spare Module*
1, 2	Baseline	1	1	96.33	98.66
3, 4	Data Sensitivity Case 1	0.75	1.25	96.25	96.95
5, 6	Data Sensitivity Case 2	0.5	1.5	93.19	93.83
7, 8	Data Sensitivity Case 3	0.25	1.75	79.56	81.09

* => shelf spares

Parameters that remained fixed for all runs included:

- Continuous operation over a ten year mission time
- Planned maintenance parameters
- Equipment capacities including 11.1 % turn-up for all modules
- Maximum output capacity equal to 10 times the nominal output of a single module
- Swapped-out-module minor and major overhaul durations (two and three weeks respectively)

For the sensitivity cases, baseline MTBF values from the baseline case were multiplied by values from the "MTBF Multiplier" column to generate new MTBF values for the sensitivity runs. Similarly, baseline MTTR values from the baseline case were multiplied by values from the "MTTR Multiplier" column to generate new MTTR values. Values used for MTBF and MTTR multipliers were supplied by others and the rationale for the particular selections was not provided.

Fidelis believes this approach provides extreme lower bounds in performance forecasts for the following reasons:

- Applying a single factor uniformly to all unplanned failure rates (MTBFs) intimates that every single item in the list is inaccurate by that factor. While this is a mathematical possibility, it is more likely that most of the data derived from credible sources reflects what can be expected in reality.
- The approach pairs pessimistic multipliers for failure rates with substantial increases in repair durations for the same components. Also, the repair duration multipliers are applied uniformly to all the baseline repair times, irrespective of the nature of the repairs. While these pairings are a mathematical possibility, it is reasonable to assert that repair durations have no strong coupling to failure frequency

Effective availability is actual output of the system divided by nominal output. This measure allows for turn-up (and turn down). Effective availability contrasts with a sometimes-used, but less-meaningful definition of availability that only accounts for binary (up or down) states.

The term "mean" as used here is a necessary qualifier for effective availability. It derives from the fact that Monte Carlo simulation is a core feature of the models. It means that for each case, results from multiple, statistically independent replications (trials) were used, each over a mission duration of ten years. Each replication generates a separate value for average system effective availability over the ten years. The mean values quoted above are the means of the separate values from each replication. 50 replications were run for cases where unplanned failure modes were engaged. Note that utilizing all the 50 results can provide confidence intervals for different levels of performance.

3. Model Details

3.1. System Configuration

3.1.1.TPM Representation in Titan

Each TPM is represented in these Titan models as an entity called a Titan "Unit". These units are connected together by Titan "Pipes". In this case the pipes mimic the actual output pipes from each unit that convey compressed air to headers that then supply air to the gas turbines. More generally, Titan pipes can be used to represent directional flow of fluids or other material, electricity, money, etc., etc.

Contained within each TPM unit in these Titan models are entities called components. A Titan component represents a particular failure mode for the unit which contains it. Titan components can be, but are not necessarily mapped one-to-one onto the physical "parts" of an assembly.

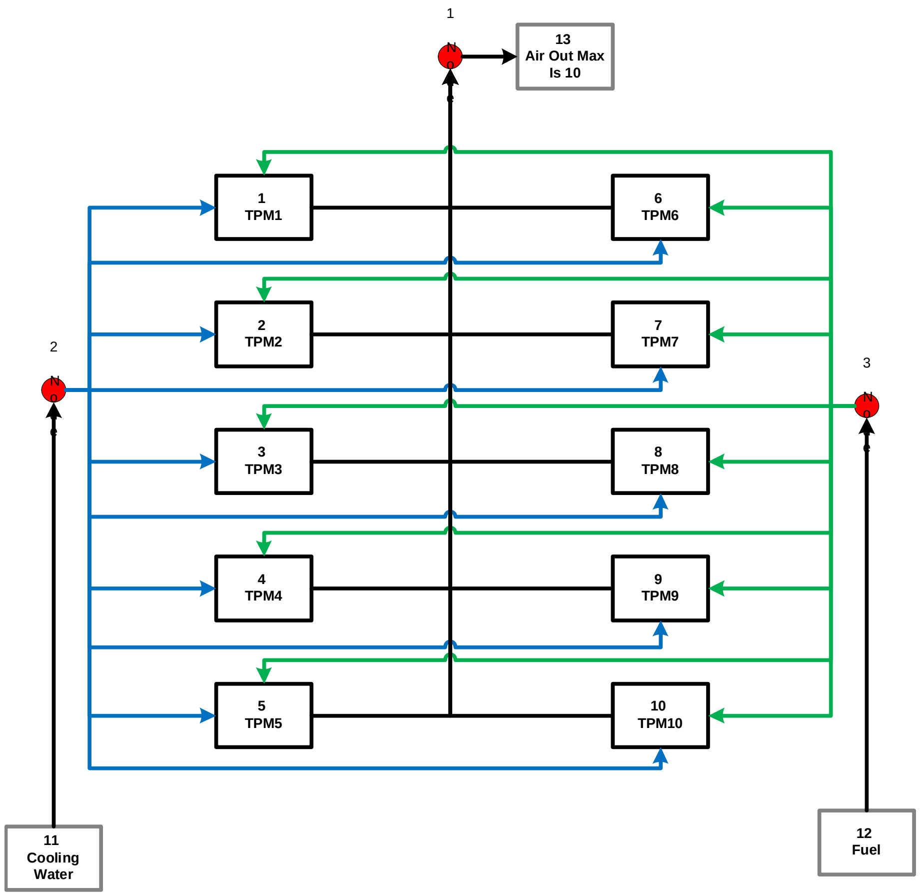
In these models each TPM's availability behavior is represented by a series arrangement of 75 components, 66 of which are active. The inactive nine components were included to enable easy addition of failure modes should that be needed in the future. A list of components and their attributes for a single TPM appears below in Appendix A. These 75 items are replicated for each

TPM unit so that the complete asset register (complete list of components in a model) consists of 750 separate items.

Behavior of the unit enclosing a set of components is governed by the states of components contained within it. As configured in the TPM units, all components (failure modes) are in series. This means that “failure” of any component, whether due to planned or unplanned reasons, renders the unit out of service. Each component has default behavior defined by probability distributions that dictate times between failures and time to repair following failure. Failure as used here means any cause for the component being taken out of service.

Each distribution is characterized by a distribution type and numerical parameters that define the shape of the distribution. Distribution types employed here include exponential, Weibull, triangular, and constant. Titan supports other distribution types including log-normal, three parameter Weibull, etc.

Below is the layout of the ten TPM system as represented in Titan. The rectangles are Titan units described above. In addition to the TPM units there are two other units that define external inputs for cooling water and engine fuel. The rectangle labeled “Air Out Max is 10” serves as a black box consumer of the total air output. The red circles are Titan nodes which are the functional equivalents of headers. For purposes of this analysis the cooling water and fuel supply units are assumed to be 100% available.



3.1.2.Parallel Operation

The system configuration modeled here consists of ten TPM modules operating in parallel. Outputs of individual modules feed into a header so that total system output is the sum of the outputs of the ten individual modules at each moment. The modules are not dependent on each other so that failure or planned maintenance of any given module does not impact the availability of the others.

3.1.3. Capacity and Turn-up

Total output of the system is constrained to be ten times the nominal capacity of an individual module. However, each TPM is designed to have 11.1% excess capacity. If individual modules are unavailable or are operating at reduced capacity, Titan's optimization algorithms will automatically turn up the other operable units to either of 1) whatever capacity is needed to meet the total system output of ten times nominal module output, or 2) the maximum available total capacity if that value is less than the “10 x” demand. This is subject to the constraint that no individual TPM can operate in excess of its 11.1% maximum turn-up.

3.2. Maintenance

3.2.1. Repair Scopes

Maintenance processes are explicitly treated in Titan. Unless overridden, the default behavior for maintenance is that each component is repaired independently of all others. However, in this case maintenance is governed by use of repair scope groups that dictate what happens when a component fails.

Failure modes were divided into three classes: repair-in-place (RIP), minor overhaul, and major overhaul. These classifications were applied to both planned and unplanned failure modes. Hence there is a total of six repair scope groups and all components fall into only one of these groups. Items listed in the RIP groups are repaired independently per the default behavior noted above.

Failures of items in either the minor or major sets have group-wide impacts, but only within a particular module (unit). Failure of a component within a minor overhaul group invokes a minor overhaul for that module and all components within that group undergo renewal. This applies to both planned and unplanned failure modes for that repair scope. Minor overhauls also renew the RIP items for that module.

A similar concept applies to failures of items in the major overhaul scopes. Triggering of a major overhaul, for either planned or unplanned reasons, renews all major overhaul items plus minor overhaul items plus RIP items.

A general feature of Titan is that it explicitly tracks cumulative run time (or age) of each component. The term “renewal” used above means the age of the repaired component is set back to zero. This means that the item has been fully restored.

3.2.2. Planned Maintenance

Planned maintenance is modeled in Titan by defining failure modes (components) that have periodic failure and repair properties. These PM components may map one-to-one onto individual, physical components of the system being modeled, or may represent activities such as oil change or plate exchanger cleaning. PM components in this model are ascribed periodic behavior using constant MTBFs and MTTRs.

Note that phasing of planned maintenance among different modules can be a complex issue, given that simultaneous planned outages are not generally desirable. Whether synchronization is beneficial can depend on numerous factors including coordination with other outages in an enterprise or supply chain. Such considerations were not part of the scope of this study.

3.2.3. Unplanned Maintenance

Unplanned maintenance was modeled using components separate from the components used to model planned maintenance. E.g., the intercoolers have both planned maintenance intervals and unplanned failure modes, each represented by an individual Titan component. Except as noted above in the discussions related to item renewal and repair scopes, unplanned maintenance events are driven by statistical sampling that is separate from planned maintenance.

3.2.4.Spares Treatment

In what follows, unless explicitly stated otherwise, the terms “spare” or “spares” refer to exact replacement items that are not installed in the system. I.e., they are shelf spares. Spares in this analysis were modeled at the unit (TPM module) level of granularity. Spares-dependent behavior was characterized as follows:

- Module swap time of one week applies for the baseline case.
- Failure of an item in either a minor or major overhaul repair scope triggers a module swap
- A two week duration is the rebuild duration for a skid that requires a minor overhaul and three weeks is the duration for rebuild with a major overhaul scope
- Implicitly, there is an assumption that shelf spares of piece parts and/or subassemblies needed to achieve the above turnaround times for skid rebuilds are available when needed. While Titan can treat such considerations, it is beyond the scope of the current project to model spares at either the subassembly level (engine, gear box, compressor, controls, etc.) or the piece-parts level. Note however that failure modes are modeled at these higher levels of fidelity.
- In cases where a spare is not available when a skid is removed for repair (regardless of whether the cause is planned or unplanned maintenance), the maximum duration of outage for that “slot” in the system is the sum of the swap time and the rebuild time.
- If one of the ten “slots” is either vacant due to module swap or is down pending RIP, the other modules in the system will automatically turn up to compensate for the duration of that outage.

For both baseline and sensitivity runs, cases for zero spares and one shelf spare were modeled. A decision about spares count depends on, among other considerations, the target stand-alone availability requirement. Also, options for installed spares (either hot or cold standby) and/or options for combinations of installed and shelf spares could be explored. Clearly installed spares could substantially mitigate issues related to module swap time.

Rigorous tradeoff analysis would require explicit consideration of gas turbine outages also. Synchronizing TPM outages with the GT outages might reduce spare module requirements to, for example, one per 15 or 20 installed TPMs. Quantifying an optimal spares strategy would require rigorous modeling of other potential TPM configurations plus the related GT management parameters.

3.3. Data Sources

3.3.1. Planned Maintenance Data

Planned outage frequencies are based on manufacturer’s recommendations and warranty requirements. Parameter values appear in Appendix A. For RIP items, the repair times were provided by Power Phase. For minor and major repair scopes, the repair times of individual items are subsumed within the duration of the entire set of repairs/replacements done for the applicable scope.

3.3.2. Unplanned Failure Data

Data for unplanned failure modes was extracted from OREDA compilations and from Fidelis' internal database. The internal database is a compilation of from past Fidelis modeling projects. This data is based on actual operational statistics from similar industries. In all cases the distributions were either exponential or Weibull.

For unplanned RIP items, repair durations were provided by Power Phase. As is the case for planned outages with minor and major repair scopes, the repair times of individual items in swapped out modules are subsumed within the duration of the entire set of repairs/replacements done for the applicable scope. Also, for unplanned failures in the contexts of the sensitivity runs, the module swap times were scaled by the MTTR multipliers.

Two exceptions to the unplanned sources description above were employed due to lack of data for major failures of large, natural gas fueled, spark ignition engines. The only alternative in such cases is to make reasonable assumptions and apply those to the model. In this case Fidelis employed the following assumptions:

1. Unplanned engine failures can be characterized based on scope of repair impacts.
2. We assumed that these correlate with major and minor overhauls.
3. We assumed that the probability of an unplanned failure that would force a minor overhaul is 10% prior to the next planned minor overhaul. The rationale for this (and item 4 below as well) is that such a value would be an acceptable warranty risk for the equipment supplier
4. We assumed that the probability of an unplanned failure that would force a major overhaul is 10% prior to the next planned major overhaul
5. We assumed that Weibull characterization with beta = 2 is valid. Beta values of about 2 are typical of rotating equipment. In what follows, we assume the reader has basic familiarity with Weibull distributions and related mathematics.

The above assumptions were used to extract Weibull scale parameter values for the two unplanned, internal engine failure modes. To do this it is necessary to solve the equation below for eta:

$$\eta = \frac{t}{\left[ln\left(\frac{1}{1-Q}\right)\right]^{1/\beta}}$$

Where t = time between major or minor overhauls, and Q is the probability of unplanned failure at or before that time (assumed value is 10%). This equation is simply an algebraic rearrangement of the Weibull cumulative distribution function (CDF).

The relationship between MTBF and Weibull parameters is not intuitive but can be calculated per the following:

MTBF = Eta * Gamma [1+ (1/Beta)]

Step-by-step results of applying these formulas are shown below for three values of overhaul frequency relevant to the Power Phase models. Columns C and F are the Weibull parameter inputs to the models:

Weibull Parameter Calculations for Unplanned Engine Failure Modes							
A	B	C	D	E	F	G	H
Overhaul Freq (hrs)	Q= Prob Of Failure	Beta	ln(1/(1-Q)	Col-D ^ (1/Beta)	Eta = ColA/ColE	Gamma [1+(1/beta)]	MTBF
24000	0.1	2	0.1054	0.3246	73939	0.8862	65527
48000	0.1	2	0.1054	0.3246	147878	0.8862	131053
68000	0.1	2	0.1054	0.3246	209493	0.8862	185659

Tabulated values for the gamma function are readily available and were used in Column G above.

Appendix A

Asset Register for Single TPM

Comp Number	Tag	Description	Repair Scope	Failure Distribution	Parameter 1	Parameter 2	Repair Distribution	Parameter 1	Parameter 2
1	TPM1-engine oil and filter	PM--engine oil and filter	PM_RIP	2P-Constant	1498	1500	Constant	2	0
2	TPM1-spark plugs	PM--spark plugs	PM_RIP	2P-Constant	2996	3000	Constant	4	0
3	TPM1-air filter	PM--air filter	PM_RIP	2P-Constant	2996	3000	Constant	4	0
4	TPM1-ignition system	PM--ignition system	PM_RIP	2P-Constant	8992	9000	Constant	8	0
5	TPM1-crankcase ventilation	PM--crankcase ventilation	PM_RIP	2P-Constant	8998	9000	Constant	2	0
6	TPM1-cylinder liners	PM--cylinder liners	PM_Major	2P-Constant	20832	21000	Constant	168	0
7	TPM1-turbo charger overhaul	PM--turbo charger overhaul	PM_Minor	2P-Constant	20832	21000	Constant	168	0
8	TPM1-cylinder heads	PM--cylinder heads	PM_Major	2P-Constant	20832	21000	Constant	168	0
9	TPM1-Piston	PM--Piston	PM_Major	2P-Constant	20832	21000	Constant	168	0
10	TPM1-vibration damper	PM--vibration damper	PM_Minor	2P-Constant	31832	32000	Constant	168	0
11	TPM1-Eng Overhaul	PM--Eng Overhaul	PM_Major	2P-Constant	63832	64000	Constant	168	0
12	TPM1-Fuel Filter	PM-TPM 1 Fuel Filter	PM_RIP	2P-Constant	998	1000	Constant	2	0
13	TPM1-Fuel Filter Regulator	PM-TPM 1 Fuel Filter Regulator	PM_RIP	2P-Constant	7996	8000	Constant	4	0
14	TPM1-TPM 1 Fuel Gas/Liquid Separator	PM-TPM 1 Fuel Gas/Liquid Separator	PM_RIP	2P-Constant	7992	8000	Constant	8	0
15	TPM1-Inlet Filter Element	PM-Inlet Filter Element	PM_RIP	2P-Constant	3996	4000	Constant	4	0
16	TPM1-Cooler Repair Kit per set of Intercooler	PM-Cooler Repair Kit per set of Intercooler	PM_Minor	2P-Constant	7832	8000	Constant	168	0
17	TPM1-Oil Cooler Repair kit	PM-Oil Cooler Repair kit	PM_Minor	2P-Constant	7832	8000	Constant	168	0
18	TPM1-Oil Filter Element	PM-Oil Filter Element	PM_RIP	2P-Constant	7996	8000	Constant	4	0
19	TPM1-Oil	PM-Oil	PM_RIP	2P-Constant	7988	8000	Constant	12	0
20	TPM1-O-Ring Set	PM-O-Ring Set	PM_Minor	2P-Constant	23832	24000	Constant	168	0
21	TPM1-Gasket Set	PM-Gasket Set	PM_Minor	2P-Constant	23832	24000	Constant	168	0
22	TPM1-PLC Battery	PM-PLC Battery	PM_RIP	2P-Constant	23998	24000	Constant	2	0
23	TPM1-Condense for Electric IGV	PM-Condense for Electric IGV	PM_RIP	2P-Constant	23996	24000	Constant	4	0
24	TPM1-IGV actuator	PM-valve actuator (electric)	PM_RIP	2P-Constant	47988	48000	Constant	12	0
25	TPM1-Intercooler1	PM-Shell/Tube HX	PM_Major	2P-Constant	47832	48000	Constant	168	0

26	TPM1-Intercooler2	PM-Shell/Tube HX	PM_Major	2P-Constant	47832	48000	Constant	168	0
27	TPM1-Intercooler3	PM-Shell/Tube HX	PM_Major	2P-Constant	47832	48000	Constant	168	0
28	TPM1-Oil Cooler	PM-Shell/Tube HX	PM_Major	2P-Constant	47832	48000	Constant	168	0
29	TPM1-V-Joint Rubber	PM-TPM1-V-Joint Rubber	PM_Major	2P-Constant	47832	48000	Constant	168	0
30	TPM1-Main Oil Pump Coupling	PM-TPM1-Main Oil Pump Coupling	PM_Major	2P-Constant	47832	48000	Constant	168	0
31	TPM1-Main Oil Pump Repair Kit	PM-TPM1-Main Oil Pump Repair Kit	PM_Major	2P-Constant	47832	48000	Constant	168	0
32	TPM1-Discharge Check Valve	PM-TPM1-Discharge Check Valve	PM_Major	2P-Constant	47832	48000	Constant	168	0
33	TPM1-Touch Screen	PM-TPM1-Touch Screen	PM_Major	2P-Constant	47832	48000	Constant	168	0
34	TPM1-Lube Oil Heater	PM-TPM 1 Lube Oil Heater	PM_Major	2P-Constant	87432	87600	Constant	168	0
35	TPM1-Plate Heat Exchanger (HT)	PM-Plate HX	PM_Major	2P-Constant	63832	64000	Constant	168	0
36	TPM1-Plate Heat Exchanger (LT)	PM-Plate HX	PM_Major	2P-Constant	63832	64000	Constant	168	0
37	TPM1-Donaldson Prefilter	PM-TPM 1 Donaldson Prefilter	PM_RIP	2P-Constant	7988	8000	Constant	12	0
38	TPM1-Recuperator/CO Catalyst	PM-Catalyst	PM_Major	2P-Constant	63832	64000	Constant	168	0
39	TPM1-Fuel Filter Regulator UFM	UFM-TPM 1 Fuel Filter Regulator	UFM-RIP	Weibull	131400	1.2	Constant	4	0
40	TPM1-Fuel Gas/Liquid Separator UFM	UFM-TPM 1 Fuel Gas/Liquid Separator	UFM-RIP	Exponential	438000	0	Constant	72	0
41	TPM1-Engine Major UFM	UFM-Engine Major UFM	UFM-Major	Weibull	147878	2	Constant	168	0
42	TPM1-Engine Minor UFM	UFM-Engine Minor UFM	UFM-Minor	Weibull	73939	2	Constant	168	0
43	TPM1-PLC Battery UFM	UFM-PLC Battery UFM	UFM-RIP	Triangular	4380	43800	Constant	2	0
44	TPM1-IGV UFM	UFM-gate valve (air)	UFM-RIP	Exponential	45704	0	Constant	12	0
45	TPM1-Intercooler1 UFM	UFM-Shell/Tube HX	UFM-Minor	Exponential	49261	0	Constant	168	0
46	TPM1-Intercooler2 UFM	UFM-Shell/Tube HX	UFM-Minor	Exponential	49261	0	Constant	168	0
47	TPM1-Intercooler3 UFM	UFM-Shell/Tube HX	UFM-Minor	Exponential	49261	0	Constant	168	0
48	TPM1-Oil Cooler UFM	UFM-Shell/Tube HX	UFM-Minor	Exponential	49261	0	Constant	168	0
49	TPM1-Main Oil Pump UFM	UFM-TPM1-Main Oil Pump UFM	UFM-Minor	Weibull	175200	1.5	Constant	168	0
50	TPM1-Bearing 1 UFM	UFM-TPM1-Bearing 1 UFM	UFM-Minor	Weibull	43890	2.2	Constant	168	0
51	TPM1-Bearing 2 UFM	UFM-TPM1-Bearing 2 UFM	UFM-Minor	Weibull	43890	2.2	Constant	168	0

52	TPM1-Bearing 3 UFM	UFM-TPM1-Bearing 3 UFM	UFM-Minor	Weibull	43890	2.2	Constant	168	0
53	TPM1-Bearing Bull Gear DrSide UFM	UFM-TPM1-Bearing Bull Gear DrSide UFM	UFM-Minor	Weibull	43890	2.2	Constant	168	0
54	TPM1-Bearing Bull Gear BlindSide UFM	UFM-TPM1-Bearing Bull Gear BlindSide UFM	UFM-Minor	Weibull	43890	2.2	Constant	168	0
55	TPM1-Plate Heat Exchanger (HT) UFM	UFM-Plate HX	UFM-Minor	Exponential	60716	0	Constant	168	0
56	TPM1-Plate Heat Exchanger (LT) UFM	UFM-Plate HX	UFM-Minor	Exponential	60716	0	Constant	168	0
57	TPM1-Recuperator UFM	UFM-gas/gas HX	UFM-Minor	Exponential	60000	0	Constant	168	0
58	TPM1-TPM Expansion Bellow UFM	UFM-Expansion Bellows	UFM-RIP	Exponential	87600	0	Constant	12	0
59	TPM1-TPM Vent Valve UFM	UFM-TPM 1 TPM Vent Valve	UFM-RIP	Exponential	45704	0	Constant	24	0
60	TPM1-Vibration Sensor	UFM-TPM 1 Vibration Sensor	UFM-RIP	Never	0	0	Never	0	0
61	TPM1-Vibration Sensor Rand	UFM-TPM 1 Vibration Sensor	UFM-RIP	Weibull	78840	1.191	Constant	4	0
62	TPM1-DP sensor + txmitter	UFM-TPM 1 DP sensor + txmitter	UFM-RIP	Exponential	65000	0	Constant	4	0
63	TPM1-RTD Sensor+Well1	UFM-RTD Sensor+Well1	UFM-RIP	Exponential	32852	0	Constant	4	0
64	TPM1-RTD Sensor+Well2	UFM-RTD Sensor+Well2	UFM-RIP	Exponential	32852	0	Constant	4	0
65	TPM1-Dummy-65	dummy	dummy	Never	0	0	Never	0	0
66	TPM1-Dummy-66	dummy	dummy	Never	0	0	Never	0	0
67	TPM1-Dummy-67	dummy	dummy	Never	0	0	Never	0	0
68	TPM1-Dummy-68	dummy	dummy	Never	0	0	Never	0	0
69	TPM1-Dummy-69	dummy	dummy	Never	0	0	Never	0	0
70	TPM1-Dummy-70	dummy	dummy	Never	0	0	Never	0	0
71	TPM1-Dummy-71	dummy	dummy	Never	0	0	Never	0	0
72	TPM1-Dummy-72	dummy	dummy	Never	0	0	Never	0	0
73	TPM1-Dummy-73	dummy	dummy	Never	0	0	Never	0	0
74	TPM1-Dummy-74	dummy	dummy	Never	0	0	Never	0	0
75	TPM1-Module	For Spares Analysis	SparePool1	Never	0	0	Constant	168	0