TIGER® Frequently Asked Questions

1. **What is it that these diagnostic conclusions give me more than the controller alarms.**
   - TIGER is checking many things in many different ways. There is a **bigger set** of things being checked than the controller.
   - Cross checks and **higher-level** integration.
   - It is possible to perform various **queries and filtering** on the messages produced to aid the analysis.
   - TIGER can look at data that does **not come from the controller**, e.g., of controller alarms on the printer.
   - **Protection versus not normal** the controller is primarily concerned with protection. TIGER looks at normal operation and tells you if anything is not normal. This may be in comparison to other turbines in the class or indeed to previous behaviour of this turbine. For example, TIGER picks up power oscillations that are damaging over the long term to the turbine. These oscillations are not reported up by the controller
   - TIGER has a **different focus level** to the controller.

2. **I can do this, I don't need to pay for software to do it for me.**
   - Yes you can, but **do you have time**? To look at 2000 tags then cross check them every day 24/7? You also need to distinguish between **troubleshooting** once a problem has become critical and **observing deviances away from normal behaviour**. You know what a problem looks like – do you know what normal behaviour for a particular turbine is?
   - **Other people can't**. They are not as skilled. TIGER will assist them.
   - You want to leverage your time. **Fault detection helps you focus**.
   - TIGER helps generating **reports** for documenting what happened.
   - All **operators** will **look at** is **alarms**. By then it could be too late. TIGER lets you know beforehand.

3. **Why are you getting the data at once per second, can I get it faster?**
   - **Yes**, we have provided this for a customer on their Allison turbine at 10x per second
   - **Once per second is the ideal compromise** – some times not necessary to have this acquisition rate and some times we will miss things because it is not fast enough.
   - Turbines designed for normal operation to have ramp rates. The industrial turbines have these such that once per second is okay.
   - TIGER captures the 20Ms alarm log from Speedtronic MKV.

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4. **I can employ two engineers full time for the price of the software.**
   - Yes? TIGER provides **continuous coverage and fault detection**. Your staff will not pick up intermittent problems.
   - Want to be able to do it yourself rather than employ engineers.
   - TIGER provides the expertise of an engineer.
   - Remember engineers have holidays, sick leave and night shift

5. **What kind of diagnostics does it do?**
   - Fault **detection** and multiple levels of **diagnostics**. TIGER reaches partial conclusions when it can. TIGER also looks at various sub-systems and across sub-systems.
   - Many different diagnostic mechanisms. We have used the **best of breed** and combined these.
   - Diagnostic **coverage is excellent** and sharpened by seeing specific problems.
   - Over **200 years** of turbine data knowledge

6. What are your main competitors?

- There is **no other product** that does continuous fault detection and diagnostics like TIGER.
- Compare to other systems . . . TIGER has Graphical display trend display and archiving – most systems do this and few have the ability to **replay** data as if it were live. But none others have Diagnostics.
- TIGER is a **vertical solution** for the gas and steam turbine market

7. What is the difference between this and a historian?

- TIGER has **diagnostics** about **specific turbines** and indeed has been tuned to **your turbine**
- It is possible in some historians to build your own simple alarms and diagnostics. TIGER has alarms and sophisticated diagnostics built in. The cumulative experience of a couple of hundred years. We are tailored to gas and steam turbines. **We focus on this and do not do anything else**.
- TIGER has the same functionality as an historian but has **more – specific diagnostics**.
- Unlike most historians TIGER keeps **all data forever**.
- Unlike most historians TIGER let you replay data at the original data collection frequency from any historical time. **Re-live the incident**. Compare this to one point every 10 minutes for PI once the data is old.

8. I have PI/Cimplicity/x already, why do I need this?

TIGER has a **vertical solution** for gas and steam turbines **built in**. PI/Cimplicity/X is not a gas/steam turbine package.

9. How many diagnostics does it have?

Thousands of fault detection and diagnostics.

10. How much will it save me? What is the pay back time?

- Consistently TIGER has paid for itself year on year and the first year. Also, we have the **$150,000 club**. Customers that have saved $150,000 in a year because of TIGER. TIGER consistently provides a payback of less than 1 year.

11. I believe your case studies, but my turbine is okay.

- One typical site we monitor **finds something new** goes wrong every two or three weeks.
- TIGER sees **faults that you don't know** about, e.g., a site extended outage from 1 year to 2 years and are looking to extend it more.
- We can install a **trial** to show problems with turbine.

12. How many installations do you have, and where?

See separate document for latest. But turbine types include **heavy duty, aero derivative and steam.** Diverse locations: UK, North Sea, USA, Australia, Malaysia, Italy, Turkey, Saudi Arabia.

- GE Gas Turbines – Industrial: Frame **5**, Frame **5/2**, Frame **6**, Frame **7**, Frame **9**
- GE Gas Turbines – Aero Derivative: **LM6000**
- Westinghouse gas Turbines: **501**
- Mitsubishi Gas Turbine: **701**
- Siemens Gas Turbines: **94.3a2**
- Allison Gas Turbines: **501**
- GE Three Stage Steam Turbine With Reheat
- Tosi Ansaldo Three Stage Steam Turbine With Reheat
- Siemens One Stage Steam Turbine

13. Can you predict when I need to shut down the turbine?

- No and yes. No automatic prediction, but get **information you need to make a better decision**.
- TIGER has **factored hours and starts**.

14. Can you predict when I need to overhaul?

- No and yes. No automatic prediction, but get **information you need to make a better decision**.
- TIGER has **factored hours and starts**.

15. I am about to do an overhaul what do I need to fix?

TIGER helps **identify** work needed and for an overhaul.

16. Can you predict when I need to water wash?

Yes. If have correct instrumentation, TIGER will give the **corrected performance**.

Then you can decide depending on your plant operating logistics when to water wash.

17. Can you predict when I need to replace blades or their remaining life?

- TIGER detects many of the **transient events** that affect blades. e.g., power oscillation causing thermal cycling

18. Do you do performance calculations?

- **Yes**, as long as right instrumentation.
- We will program calculations if you want.

19. Do you do NOx emission calculations?

Yes. Have 30 minutes average and projected average with right data feed.

20. What is the difference between TIGER and a vibration monitoring system?

- See visual diagram in brochure/presentation.
- TIGER looks at whole range of systems in the gas turbine. Vibration only does diagnosis on moving parts but at great detail. We have overall vibration in TIGER. This can be used to detect a problem and then a vibration system can be used to diagnose the problem. TIGER and vibration monitoring systems **compliment each other**.
- Most problems are with ancillary systems on the gas turbine. **80-90% problems are not vibration** related. More bang for buck with TIGER since looked at whole range of sub-systems on the turbine.
- Can install with turbine running. No new sensors.

21. What is the return on investment?

Consistently paid back in a year – year on year.

22. How will it help me to save money?

- Reduce down time.
- Prevent unexpected trips by identifying problems early.
- Identify hot gas path stressing.
- fix problems early before they become major.
- More efficiency from the turbine if run smoothly.
- Help detect early signs of catastrophic failure e.g., pilot nozzle drops off.

23. What hardware will I need?

Modern PC and digital data feed from your controller. Windows 2000 or XP.

24. What kind of diagnostic mechanisms do you have?

Limit checkers, step detectors, rapid change detectors, general rule system, specific models and higher-level rules.

25. Do I need extra sensors?

TIGER can **work with existing sensors**. May wait to add others for TIGER to take advantage.

26. What controllers do you connect to?

- Generally we connect to HMI's rather than controllers, except when the controller is old and here we connect into an existing data steam.
- HMI's we have connected to
  - GE <I> processor using modbus
  - GE Cimplicity using OPC
  - PI using DLL calls
  - Wonderware using DLL calls
- Controllers we have already connected to
  - GE Speedtronic Mk IV via an existing data dump
  - Speedtronic Mk V by MODBUS connection to <I> processor and OPC connection to Cimplicity
  - Speedtronic Mk VI via OPC and direct connection to Wonderware
  - Teleperm XP using OPC

27. Can you connect to my controller?

- **Yes**, as long as you have a spare **digital data feed** with a **documented** format.

28. What turbines do you currently monitor and how many?

- At Turbo Services Network, we monitor turbines
- There are lots of monitoring centres that use TIGER to support Long Term Service Agreements or In-house needs. For example
  - 2 companies in Glasgow, Scotland
  - Company in Italy with remote stations throughout Italy.
- Sometimes users will do their own monitoring independently of any LTSA

29. How many turbines can a single PC monitor?

Two gives good performance (The max we have ever done is 5 on one PC)

30. If one PC can do 2 turbines, do I only buy one TIGER?

The number of PC's is not relevant. The **TIGER licence is per turbine.**

31. Is TIGER used in a 24/7 monitoring centre? Where? Can I see it?

- We have experience in building such centres and can help you set one up.
- **24/7 is not needed** if you use **TIGER** regularly as it **predicts problems**
- Have **phone message and email** connections on a per diagnostic basis
- Generally the **monitoring centres are not grandiose** things with big screens and displays. They tend to be **dispersed** with TIGER on individuals PC's and laptops. There is not much to see.

32. We have a policy of no external phone lines, can you still monitor my turbine?

- We can use a **special box**, which behaves like your own firewall. Any phone call that does not have the decoder is not aware of modem. Transparent as far as the modem is concerned – goes between the phone line and the modem, not the modem and the computer.
- TIGER can be configured to use any port you want. This allows you to set it up securely to go though **corporate firewalls**.
- Not need to use a phone line full-time, can ask an **operator** to get it **switched** to TIGER.
- TIGER can connect over the **internet**.
- If really no connection, then **send the data on CD** and we will analyse and produce reports.

33. The gas turbine is just one part of the power station. I want a diagnostic system that covers all the plant – steam turbine, boilers, cooling water, gas supply, heat recover steam generator (HRSG) coffee maker.

- We need a digital data feed. Our plan is to cover everything in the power station. We can handle multiple controllers
- We are looking for lead site for this, are you willing to work with us?
- We will develop these capabilities over time.

34. You haven't done my turbine model, it is useful to me?

- Some of the **generic diagnostics** will apply
- TIGER has generic coverage, data archiving and graphing.
- We then work with you to **build new diagnostics**..

35. What kind of connection do I need to connect to my turbine remotely?

Anything that runs **TCP/IP**.

36. Can I monitor my turbine over the internet remotely. From a web-browser?

Yes communicating over the web**, no** not from a web browser. TIGER can communicate across the web, including connecting to remote access and excel. You need some TIGER functionality at both ends. Normally you would have a remote TIGER at one end and the data acquisition TIGER at the other. Need internal IT infrastructure to support a web connection and this is usually not there.

37. How long do you keep data for and at what resolution?

- **Forever**.
- **Once per second** on CD's, DVDs.
- 5-10 years on hard disk.

38. How does the system do backups?

Standard Windows software.

39. Can you do hot gas path analysis predictions?

- TIGER detects events that affect part life and **detect** these **early** so you can do maintenance to get rid of the issues that are causing undue wear and tear.

40. Do you do parts tracking?

Yes, we can discuss requirements and needs in detail.

41. How did you develop the diagnostics.

- Analysed past examples use computing science and turbine knowledge to put diagnostics in.
- Busy improving diagnostics all the time based on experience and turbine knowledge
- Some specific diagnostics are requested from sites.
- Initial boot strap was from John Brown Engineering in Glasgow as part of a European funded project to apply leading edge research to a real-world problem

42. Does the system learn?

Yes, we use **Guided learning**. TIGER is highly parameterised and is auto tuned to your turbine. We use people to do more complex diagnostics.

43. Does the system auto-tune itself?

Yes (partially). Generates limits with confidence factor, plus also suggested limits displayed graphically for the data set under consideration.

44. Can I integrate my own diagnostics and models into the system?

Yes. We can help. Have done this for a number of customers.

45. How open is the system, can I get data out?

- **Text format** is available from direct data requests and as a dump of graphs and trends
- **Access/Excel** DLL's mean you can query the TIGER data from visual basic macros

46. What aspect of the software uses artificial intelligence?

Rule based diagnostics – 2 forward chaining rule bases.

47. What are your unique selling points?

- **Fault detection and diagnostics for gas turbines.**
- **Look at diagnostics not data.**
- **Troubleshooting better than any other tool.**
- **Remote connection.**

48. Are the diagnostics always right, what is the confidence factor, can I trust them?

- Diagnostics call what they see. Evidence for that conclusion exists, but in many cases we do not have sensors to discriminate between possibilities. We can't diagnose everything. TIGER's is not the final and only conclusion! This is a tool to **help you focus** and bring to your attention abnormalities.
- No confidence factors because we call what we see.

49. Do you have a confidence factor against each diagnostic?

No, but we do have **levels of severity**

50. Do you use fuzzy logic?

No, Fuzzy logic is normally used to chain borderline conclusions together in long inference chains. We don't have long chains.

51. What kind of rule base is it?

Two forward chaining rulebases that cascade (starts with data and iterates). This then feeds the high level rules which forward chains again with special temporal extensions.

52. Can I modify existing diagnostics?

You can change parameters. We can train you to do this.

53. Can I create my own diagnostics?

- It is easier for us to do it, but We can train you to do this
- Normally people don't have time and skill.

54. Can I create my own screens?

Yes, these are defined in config files.

55. How reliable is the software?

Very reliable. Runs 24/7. The software is 8 years old. The few site failures have been due to hardware rather than software.

56. What operating system does it use?

Vista/XP/2000 but can at a pinch do 95, 98, ME. Can do Unix, but at a cost and with limited user interface.

57. Can I produce management reports? What kind of reports does it produce?

Can be used to make reports today. We do this using cut and paste.

58. How often do you update the diagnostics/software?

Update every 9 months.

59. What do I get for the maintenance contract?

- We have an eight-man software team working on TIGER diagnostics and functionality.
- You get these new features..
- Software support, e.g., for hardware upgrades, site changes

60. Can I have a version in my local language?

Yes – we change the message file – there will be a cost.

61. I don't want another screen in the control room. Can you integrate with the DCS?

Depends on what the DCS is. Could potentially run on an existing PC as a TIGER viewnode. We have sent alarms back to the DCS for a customer.

62. Will you do the monitoring of the turbine for me?

Yes, for a fee. We can support you in any way you need.

63. Will it advise me of how to fix the problem it has identified, will you do this?

- Will only tell you what it sees is not correct. **We have people that can help in advising what to do**.
- Most customers do this themselves.
- Remember that whilst TIGER detect most things it cannot diagnose everything.

64. Are the reports included in the scope of supply

Optional, for a fee.

65. Can I send Alarms generated by TIGER to Other systems?

Yes. Alarms can be made available to

- any **OPC client** via the TIGER OPC server
- any **PI system** by directly setting PI alarms

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