Walt Vinoski
1-724-713-1753
walt@vinoski.com
walt@vinoskiengineering.com

Vinoski & Associates, Inc.

LATENT DEFECT DESIGN REVIEWS
ROOT CAUSE INVESTIGATIONS
INSURANCE CLAIM SUPPORT
DEVELOPMENT, EPC, LTSA

Offices across the USA
& London, Great Britain

Resources USA & UK

- Energy, Power, Transmission, Machinery Support
  - Locations: Pittsburgh, Pennsylvania, Arizona, Arkansas, California, Florida, Illinois, Massachusetts, Oregon, Texas, Wisconsin, Wyoming,
  - Dozens of Engineers / Specialized Experts
    - Architect-building, chemical, civil, controls, electrical (generators, transmission & distribution AC & DC), fire investigation, large rotating equipment, lightning experts, marine, mechanical, nuclear, solar (photovoltaic, thermal), steel & aluminum mills, turbines (combustion, steam, solar, & wind systems), reciprocating engines, and vibration expertise.
    - On-shore and limited off-shore experience
  - National Association of Fire Investigator Certified
  - 3 metallurgists
  - Lightning experts
  - Civil & Architectural engineers

Power, Energy, and Transmission

- Our Claim Expertise, Accurate RCAs, for LM, LMS, F, G, H, & J Technologies.
  - O&M, repairs, design, owner's engineers, power purchase agreements, service contracts, construction, functional and performance testing, and failure modes.
    - Nuclear, coal, natural gas, hydrogen, LNG, hydro-electric.
    - Gas turbines, steam turbines, reciprocating engines & generators, pumps, mills, etc.
    - Jet engines, aerospace engines, aerospace diesels. Weapon systems and other devices
    - Transmission, distribution, substations, switchyards, high-voltage inverters
    - "Green" biomass, wood, methane, wind, solar thermal & photovoltaic
    - Ancillary equipment: SF6 breakers, transformers, synchronous condensers, black start capabilities, boilers, HRSGs, CEMS
    - Pipeline, distribution, transmission, scrubbing, & delivery
    - Civil and structural design, faults, demolition, and restoration work.
    - Explosives demolition, errors, risks, and monitoring.

Root Cause Analysis

- RCA investigations, allowing the insurer and the insured to find the actual root cause and who was at fault.
  - The OEM "determined" that the operator was running the HP Turbine too hot and provided a multi-million repair option. Insurers requested VAI investigate
    - VAI found the failed HP Impulse Wheel was improperly repaired.
- Latent design defects expertise
  - For H & J Hot Gas Path components.
  - For Hydrogen Burners
  - For High Pressure Compressor damages
  - Blading design short-comings, incorrect root design applications, etc.
  - Steam turbine failures including water induction, windmilling, seal failure

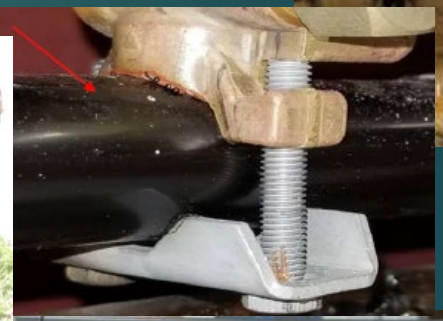
Sand and dust do not destroy bearings

Cause of Accident / Death

- VAI expertise in determining
  - Cause of accidents and
  - Cause of death.
- Providing legal support
- Modeling
- Visual support
- Accident investigations

Lab Product Liability Testing

- Wind turbine blading
- Electrical Testing of Appliances
- Modeling of Transformers
  and electrical apparatus.
- Testing and Failure Modes Analysis
- Design defects
- Legal support
- Root cause
  - Lab work
  - Field work

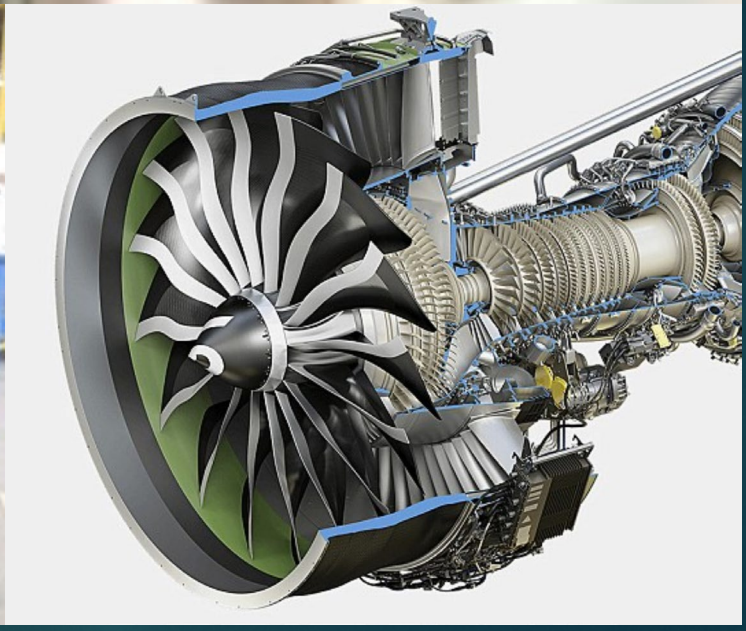


Value Added

- Columbia, S.A. 125 MW hydro unit, with seven major arc-flash damages to the stator, due to the loss of a grounding line.
- The OEM stated that it would take 18 to 24 months to deliver a new stator.
- We provided an immediate repair solution,
  - Getting the unit online in two months safely achieving 119 MW of the 125 MW.
  - Gave ample time to the utility to install a 135 MW upgrade 5 years later.
  - No BI loss;
  - PD less than the deductible.

Aerospace, Aviation, Jet Propulsion, etc.

- Claim Damage.
- Reparability.
- Replacement Valuations.
- Salvage



OEM "Cannot determine the Root Cause"

- With a quick on-site investigation.
  - A focused VAI metallurgical examination.
  - A quick review of the commissioning records.
- The cause was determined to be poor execution in commissioning by the OEM.
- Warranty – Poor OEM Workmanship.

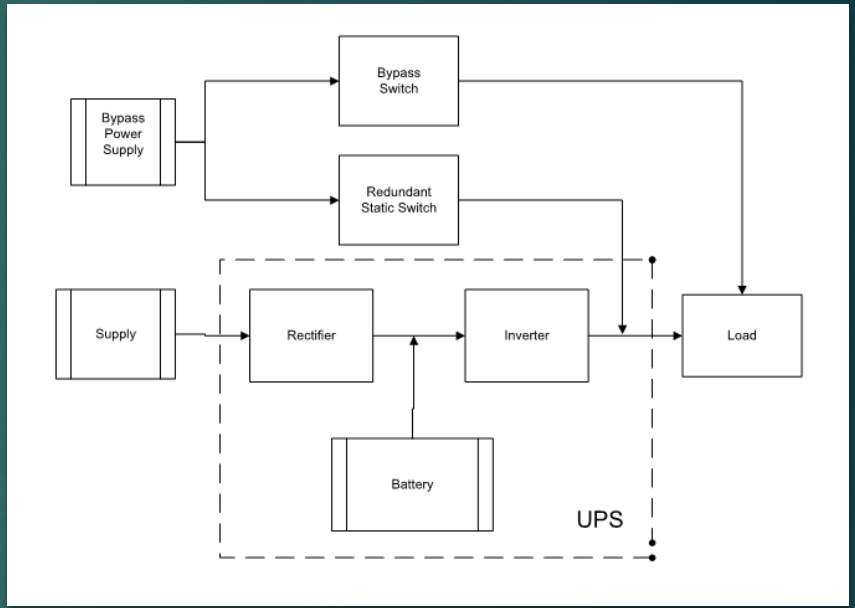
4th Stage Tip Liberation from poor commissioning on fuel oil.

SF6 Breaker Damage

- SF6 Breaker trips out and reported as damaged
- Plant reports fire or electrical arc-flash damage.
- A handkerchief removed the oxide layer (black)
- OEM states 6 months replacement for B.I.
- Site inspection of the SF6 Breaker reveals that the seals were damaged compromising the hermetic seal due to a lightning strike.
- The plant could only run one unit. VAI told the plant that the protection circuitry worked and that they did not need this set of SF6 Breakers – so by-pass them with a cable.
- While that idea was first thought to be hazardous and unsafe, the OEM explained it was indeed safe. The by-pass was installed and the SF6 Breaker repaired with "spare parts"
- Downtime reduced to 10 days!

550 MW STG Loss of DC Power

- The DC Power for the Lubricating Oil System Failed resulting in no lubricating oil during a coast down.
- Bearings, Seals, and Blading were damaged during the Event.
- VAI design review showed multiple failure modes and effects.
- Conclusion in VAI report stated: "Unless at least two of recommended controls changes are implemented, there will be another Loss of Lube Oil Event on this turbine within a year."
- There was another loss before that year ended.
- The insurers asked us to do an EPC Design Review, we listed several un-safe modes of failure. This design was used in 6 other power plants in South America.



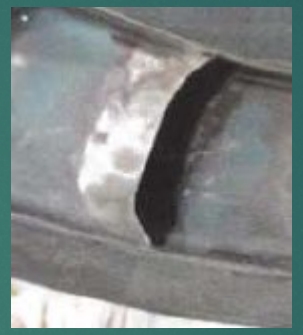
6,500 HP Motor- Red Gear-Ball Mill

- Three years of failures on an old ball mill with rebuilt motors.
- Neither the motor manufacturer or other parties could determine the root cause of the motor failures, including cracked spider welds.
- VAI was called upon to analyze all the vibration data, the shop motor damage, repairs and other documentation.
- Within a few days VAI determined a torque issue Rick O'Mahony determined that the damage, as supported by our vibration expert, were occurring during startups and Rick declared that one of the soft-start liquid resistors was the problem.
- After VAI's finding were conveyed to the plant; the plant confirmed it to be true. It continues running to this day without any downtime.

OEM Blames Owner for Damaging H.P. Impulse Wheel

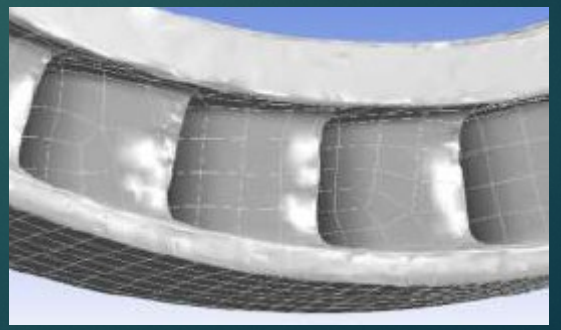
- Vinoski & Associates, Inc. – Led by Dan Kelso with the support of our metallurgist Joe Daleo prove the OEM compromised the blades, making them susceptible to steam admission excitation and subsequent failure.
- The claim gets turned over to the OEM, saving the insurance company millions.

OEM blade cut back too far.



Changes excitation frequency, & blade liberates

VAI FEA model proves the excitation



6 MW STG Rotor Liberation

- STG remote controls were not working.
- Cannot reduce load as the admission valves will not close.
- Plant personnel hit the E-stop, which is just another switch for the remote control. The valves get the same signal to close but do not. With the E-stop the generator main breaker opened, resulting in a 6,800 rpm overspeed failure.
- This happens frequently. What should have occurred is to manually close the turbine steam header root valve as quickly as possible.

LM6000 Old Compressor Blade Design

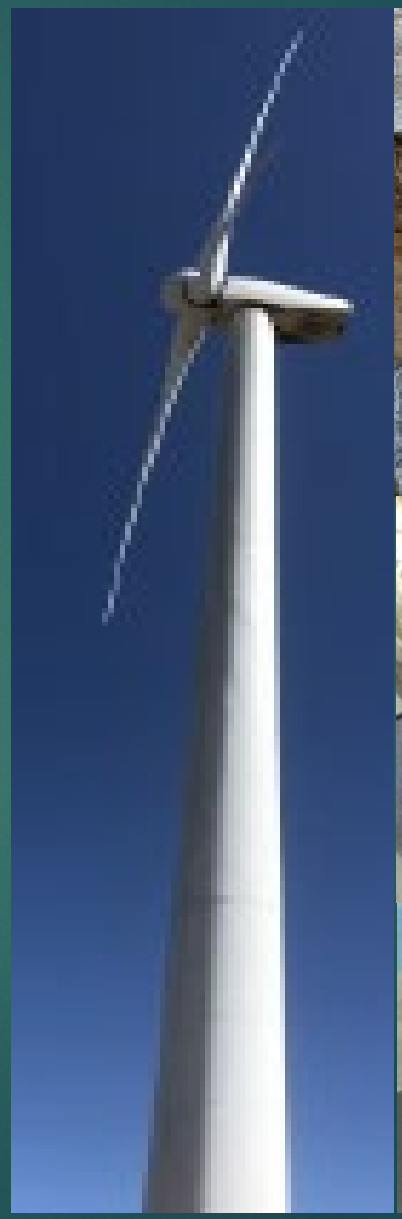
- OEM upgrades compressor blade root design
- The timing of the upgrade requirement is not clear
- 5th Stage blade liberates causing downstream damage
- As normal, the "repairs" include wear, and damage from previous incidents.
- Claim gets greatly reduced.

501J CTG 330 MW

- Builders All Risk – Contamination of steam cooled transition piece(s).
- OEM initially wanted to replace 8 TPs and inspect 12.
- We participated in the TP inspections, at night and on the weekend. OEM declared 5 had to be inspected for contamination, although no contamination was visible – only water marks (dried deposits).
- We had the OEM inspect their brand-new replacement TPs to show them that after welding they all are water washed and then dried – and all had the same water marks.
- Only two TPs required a water flush.
- The final claim damage was appropriately reduced to maintenance activities.

Wind Turbine Generator

- Latent Design Defects:
  - Mechanical
  - Electrical
  - Controls
  - Materials/Fabrication
  - Earth-grounding & Lightning Protection
  - Wind-farm Electrical Distribution
    - Design Errors
    - Protection Errors
    - Transmission System Weaknesses

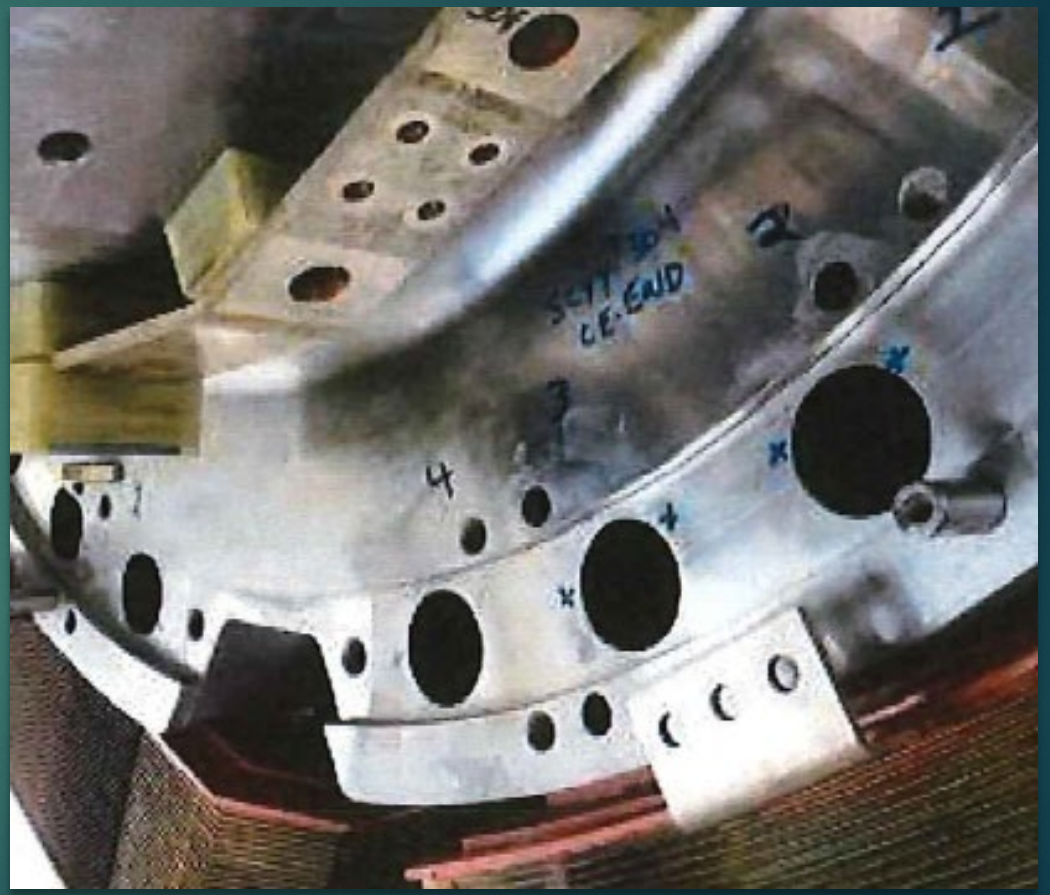


Solar Energy Thermal/Photovoltaic

- Latent Design Defects
- Mis-managed Upgrades
- Operational Damages
  - Distribution
  - Electrical
  - Controls
  - Materials/Fabrication

250 MVAR Synchronous Condenser

- These devices are essentially motor/generators that are used to regulate VARS.
- New units with only 4,000 hours developed rotor pole cracking
- An RCA is underway, to clarify a manufacturing problem, in that the original design allowed too great of stress risers.



250 MVA Transformer - Derailment

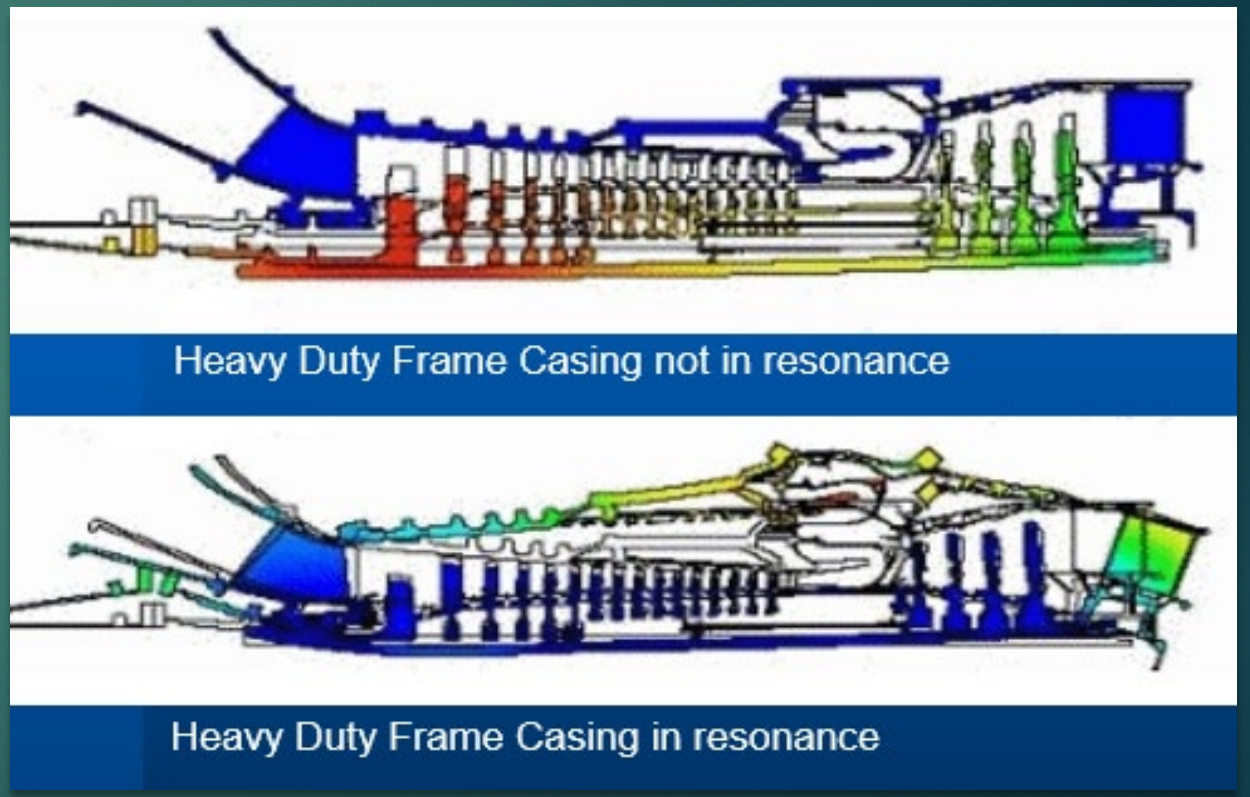
- Superficial Damages
- OEM rejected the unit, per the policy.
- OEM stated they could not economically repair the unit.
- The damaged transformer was later purchased for scrap value and then repaired.

Argentina, S.A. Transmission Distribution

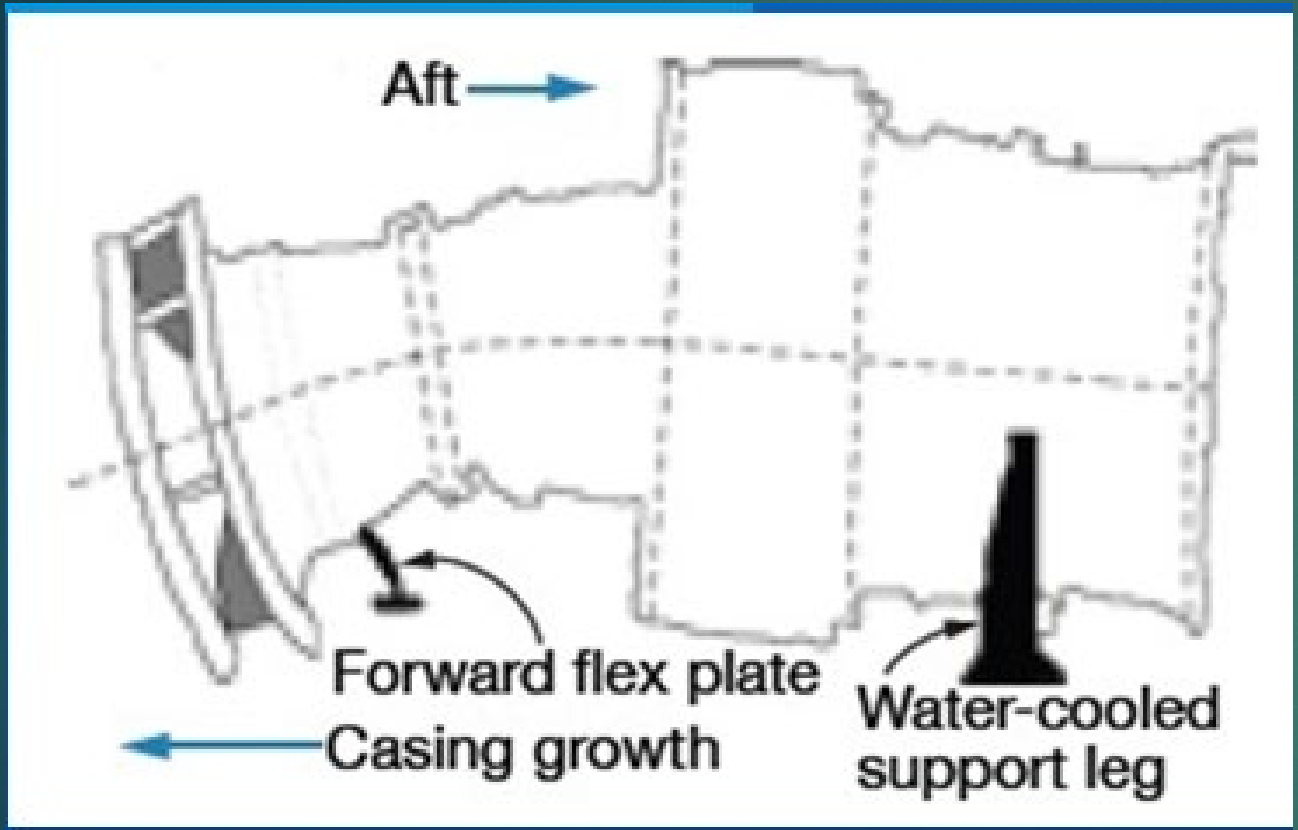
- Underground 230kV Line arc-flash
- $17 million in repairs expected.
- New repairs to a 45-year paper insulated line induced secondary cracking and compromised the integrity of the paper insulation (causing cracking).
- It was less expensive to pull 92,500 feet of all new XPLE cable
- Our repair plan succeeded to repull all new cable for $3 million.

Compressor Clashing ("Surge")

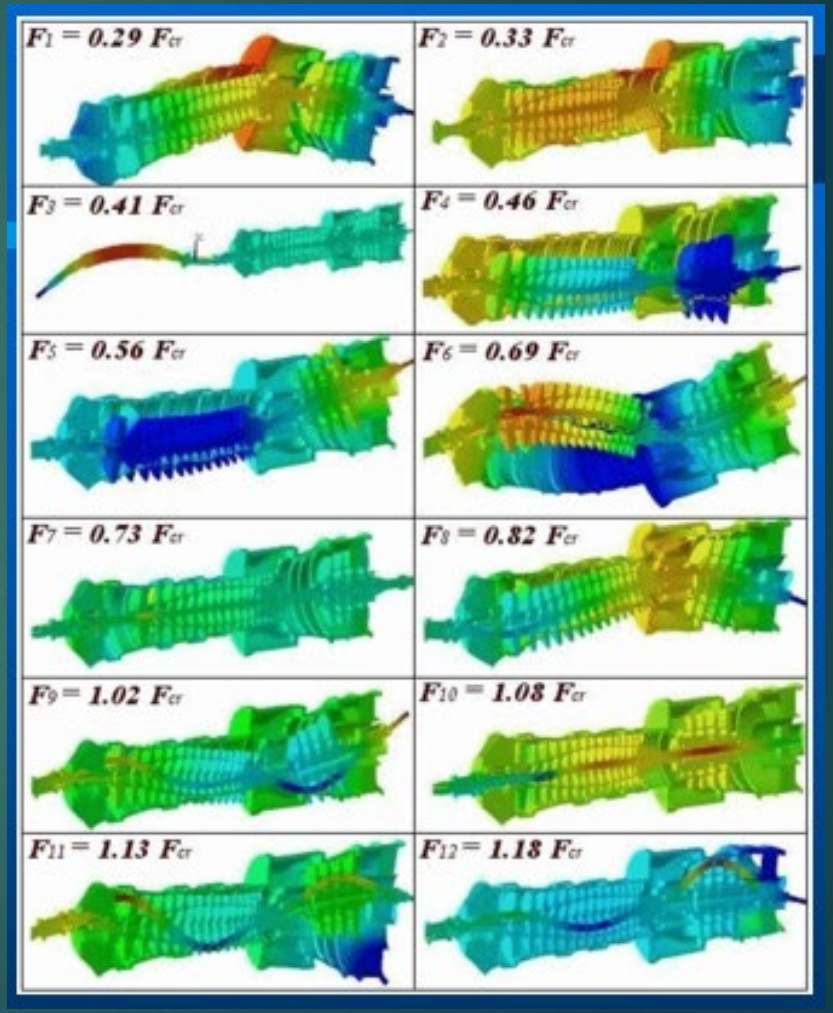
- OEMs blame operators for their loss.
- Clashing often is based on "surge conditions"
- Clashing is due to the physical flexing of the outer casing.
- At the right are two clips from a modal model.



Clashing viewed with reading glasses



Differential Cooling & Non-uniform Thermal Expansion cause clashing.



Combustion Turbines: G, H, & J Technologies.
Cooling issues remain, not an operations problem.

Experts

- Walt Vinoski – Siemens-Westinghouse & MHI CTG, Steam Turbine & General Power plant, FEMA
- David Kalmanovitch (UK-based) – Metallurgist, Turbine Hot Gas Path and Boiler corrosion expert
- Paul Markham (UK-based) Power Engineer, conventional turbine-generators, renewables
- Georg Nauman – design, fire/water piping, structural, modeling, loading.
- Wendall Moulder – Nuclear, Power, Gas/LNG Startup Boiler Expert. UK, South Africa, Mexico, Canada, Indonesia, Thailand, and Singapore.
- R. "Bucky" Croushore. Civil Engineer – Power plant structural steel. Bridge damages repairs, designs, and claims reviews.
- Dudley Green – GE Combustion Turbine expert, general steam turbine expert
- Mike McNeil – Electrical Engineer – Apparatus, Root Cause Analysis protocols, Fault Tree Analysis, Life-cycle Planning
- Rick O'Mahony – Electrical, Generator designer/repairs, switchgear, transformers, and grounding. Wind Turbine experienced
- Jack Bahnak – Electrical, Transformers, Electrical apparatus, turbines, wind turbines, & Product Liability Testing
- Kim Eiss – electrical generator expert
- Rick Johnston – Chemical Eng. Layer bonding and defect issues
- Dr. Fuchs (USA), Dr. Kalmanovitch (London), - Materials, bonding, manufacturing.
- Dan Kelso, turbomachinery, bearing designer, wind, general plant design, maintenance.
- Helmut Nauman – Steam and gas turbine designer
- Robert Shallenberger, materials engineer – quality controls
- Dr. Uman – Earth grounding and lightning expert
- Mark Bennett – Startup and O&M expert for coal and combustion turbines.
- Joe Jaskulski – certified fire inspector
- Dick Johnston – GE & P&W aero derivative turbine design engineer
- Ralph Leidy. Powerplant O&M Expert, Turbine Machinery Operations, and Maintenance expertise.
- Justin Jeffcoat. Crane, rigging, and lifting expert.
- Gene Borrows – Wind and power plant startup and construction manager.
- Robert Bizzak. NRC designer, piping and rupture expert.
- Various Controls Experts, Process Engineers, Civil Engineers, and Construction/O&M Experts