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COAXIAL INPUT RF LOADS

Doug Horan

RF Group Cross-Training Session

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Presentation Outline

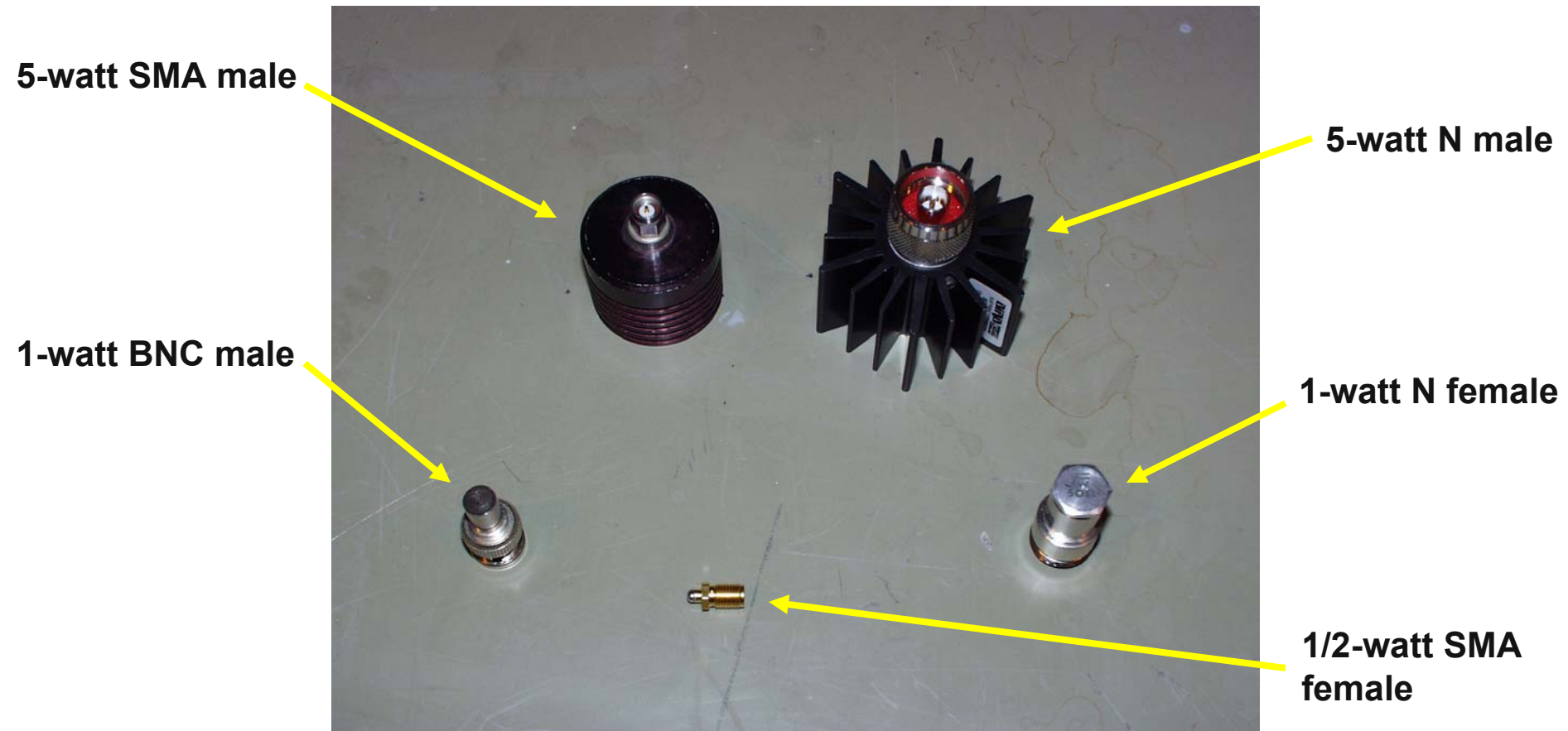
1. Description of RF load types.
2. Details on Altronic Research Water-Cooled RF Loads.
3. Details on “CERN” 300kW Water Loads
4. Load Replacement Procedure
5. Conclusion

RF Load Types

- RF load designs are determined by *impedance*, *power handling capability*, *cooling method*, and *frequency range*:
 - Power handling capability: 1-watt, 10-20 watt, 100-300 watt, or many kilowatts
 - Impedance is typically 50 ohms unless otherwise stated
 - Quality of match can vary from good (typical for “loads”) to excellent (typical for precision “terminations”)
 - Cooling method could be ambient air, forced air, closed-system oil conduction to air fins, forced water, etc.....it depends on the power levels involved
 - A “broadband” rf load will represent a 50-ohm match with low VSWR over a specified frequency range, but some loads are designed to be a good match at only one frequency

Low Power RF Loads

- Average power dissipation typically ranges from ½-watt to 5 watts, with various connector options.
- Power is dissipated in resistive material thermally bonded to a heat sink. → *will read 50Ω with a dc ohmmeter*



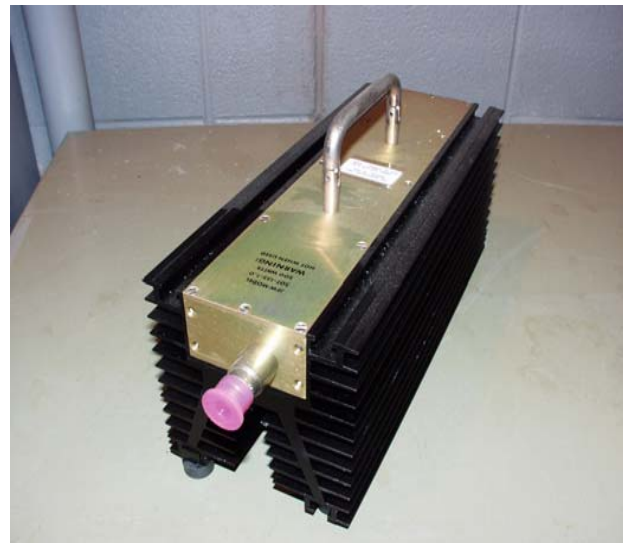
Moderate Power RF Loads

- Power is dissipated in a resistive material bonded thermally to an air-cooled heat sink or immersed in oil that is air-cooled by fins.

→ *Will read 50Ω with a dc ohmmeter*



100W air-cooled



200W air-cooled



300-watt oil/air cooled

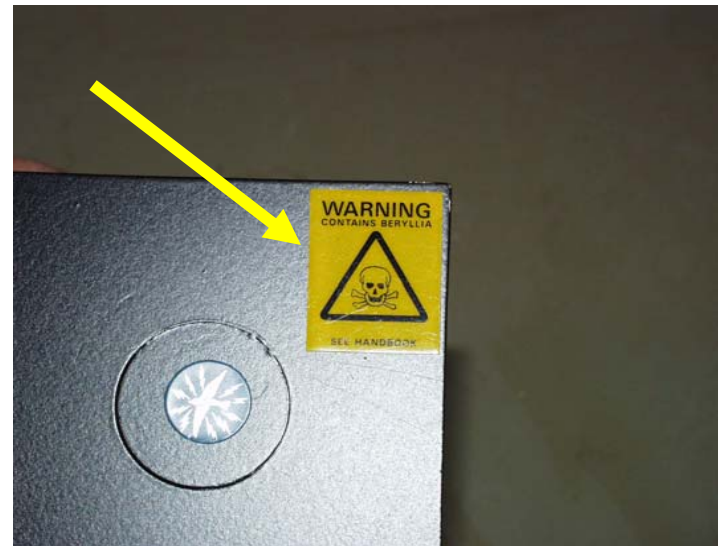
Beryllium Oxide Warning!

- ***Some loads use BeO ceramic internally as a dielectric material because of its low rf loss and excellent thermal properties.***

→ ***If the load case is breached or you disassemble the load, do not touch the BeO ceramic material.***

→ ***Do not abrade the BeO material, or ingest dust from abraded BeO.***

→ ***In some cases, BeO ceramics are intentionally colored pink for identification.***



Moderate Power RF Loads

- 50kW load used as a television transmitter dummy load

- *3-1/8" EIA coaxial flange input*
- *Forced-air cooling with circulating coolant -- oil, or glycol-water mixture passed through an internal heat exchanger cooled by fans*
- *Will read 50 Ω with a dc ohmmeter*



Altronic Research Water-Cooled Loads

- **Broadband rf loads with EIA coaxial flange terminations:**



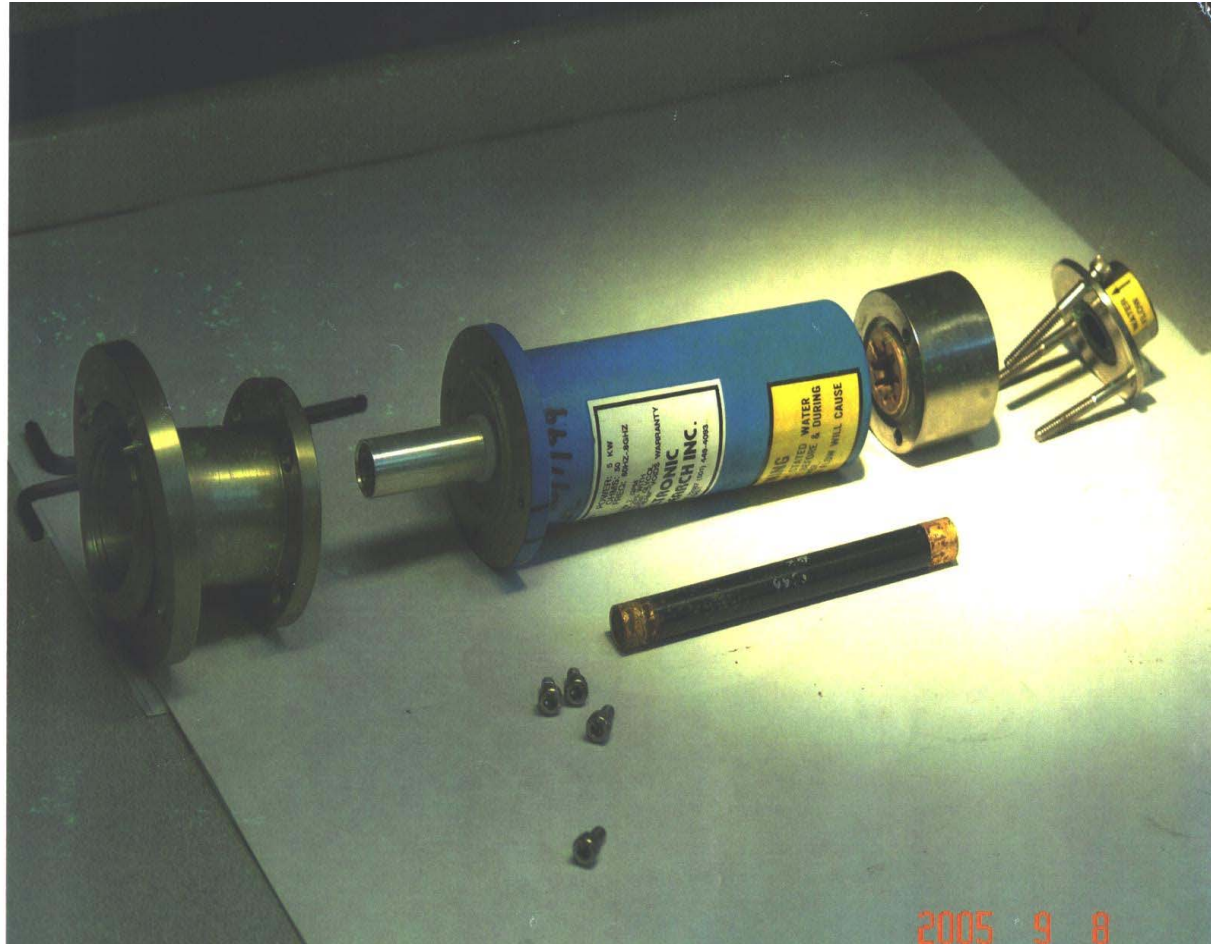
200kW with 6-1/8" EIA flange



5kW with 1-5/8" EIA flange

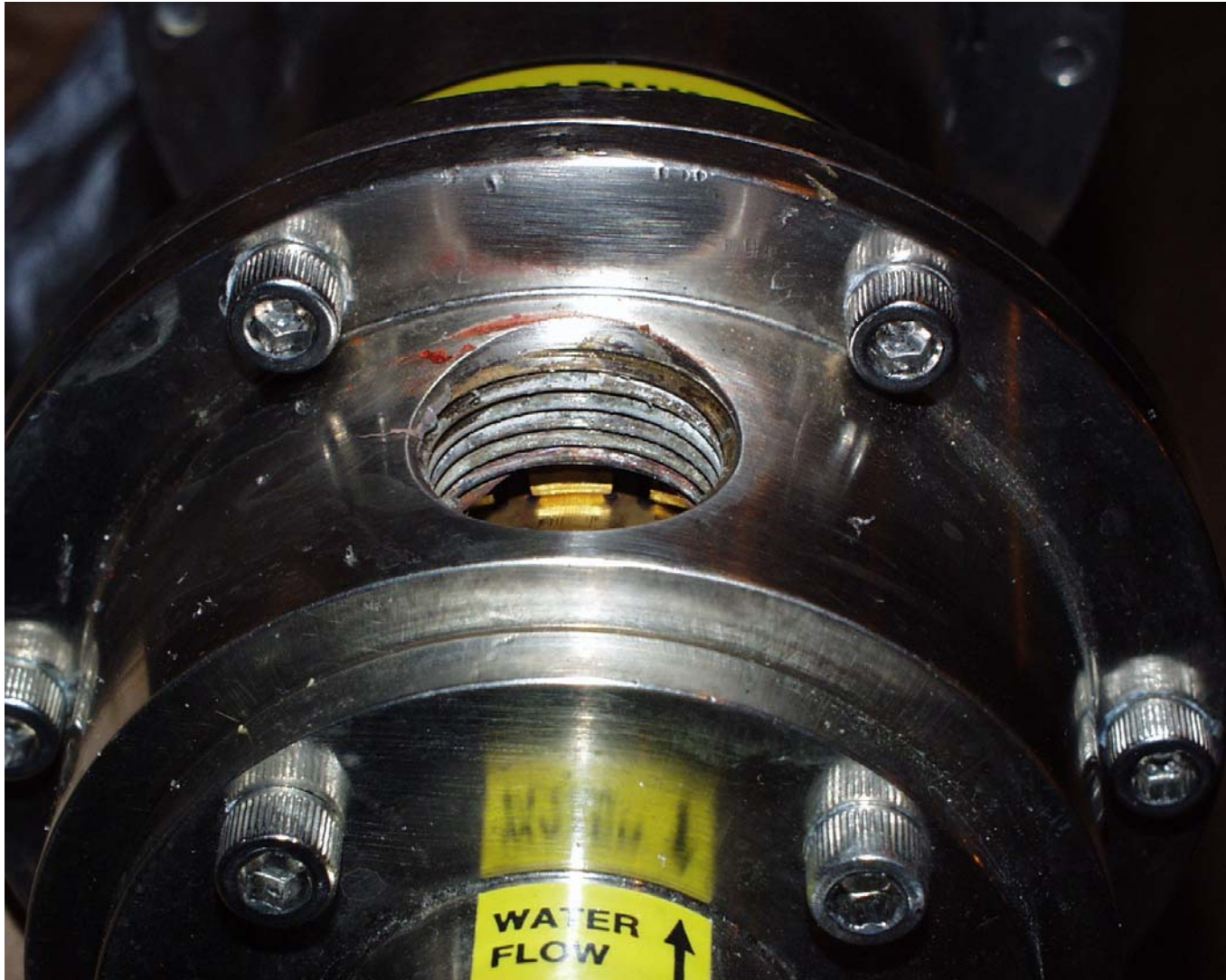
Altronic Research Water-Cooled Loads

- RF power is dissipated in a resistive coating that is applied to the surface of a ceramic tube
 - The ends of the ceramic tube are metalized to provide rf contact to the resistive coating
 - The resistive coating is cooled by a very thin laminar water flow confined close to the surface of the resistive coating by a teflon water jacket
 - Cooling water enters through the center of the tube and returns by the laminar path
 - Broadband – *reads 50 Ω with a dc ohmmeter!*



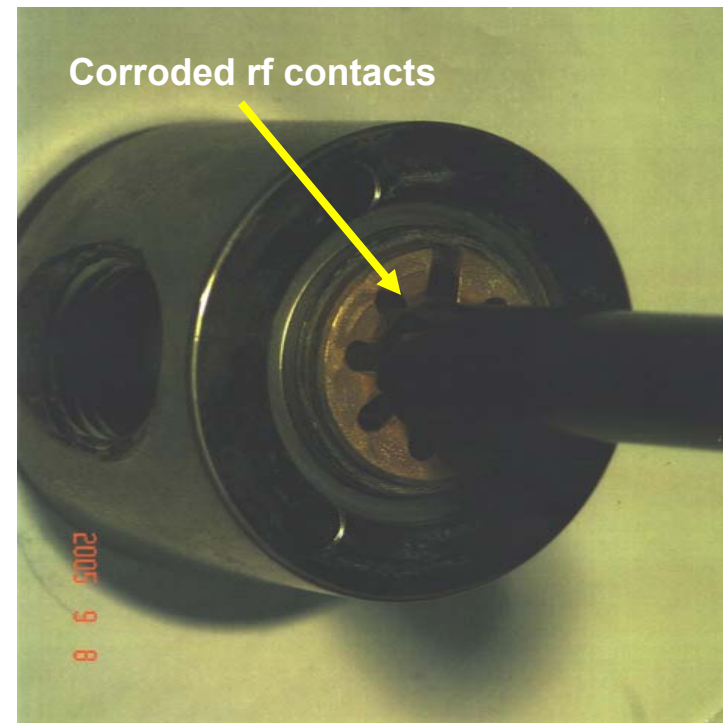
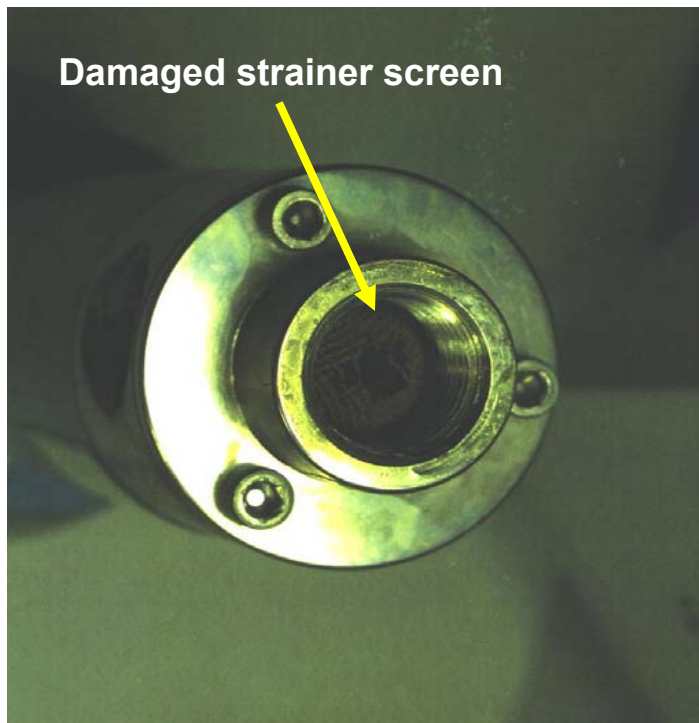
Altronic Research Water-Cooled Loads

- *View of rear rf contacts to resistor tube on a 200kW load:*



DI Water Effects on Altronic Research Water-Cooled Loads

- Corrosive effects of high-purity DI water causes erosion of rf contacts by dissolving the metallic contact parts and de-plating the resistor – *which will result in arcing at high power!*
→ three-year maximum service life between rebuilds in our systems



CERN 300kW Water Loads

- Shorted coaxial line with DI water in dielectric region
 - *RF power is dissipated in the cooling water itself*
 - **NARROW BAND** – *only a good match at 352 MHz!*
 - *Load impedance is approximately 10 ohms – a coaxial transformer (tapered center conductor) is used to correct input impedance to 50 ohms → reads 0Ω with a dc ohmmeter!*
 - *Very rugged.....but can fail due to arcing at the transformer if input power exceeds 300kW.*



Transformer coaxial section and center conductor



Water weep holes in transformer section

Care and Feeding of Coaxial RF Loads

- **Follow guidelines in RF Technical Note on rf load replacement:**
 - **CCWP required!**
 - **All 352-MHz rf stations must be off and LOTO before load is removed!**
 - **17.5 ft-lbs torque on flange bolts!**
 - **Sniff flange for rf leaks after replacement!**



NOTE: Minimum flow on 200kW loads is 19 GPM!

Altronic Research 200kW Water-Cooled Loads

The result of operating full input power *with no coolant flow* and *no functioning interlocks!*

**OPERATION WITHOUT COOLANT FLOW
WILL RESULT IN INSTANTANEOUS LOAD FAILURE**



Care and Feeding of Coaxial RF Loads

- *In horizontal mounting, orient the load so that weep holes face the floor as best as possible:*

