1 Graphite Specification

ThorCon's graphite needs are similar to those of a prismatic HTGR. Dimensional change as a function of fluence and temperature is very important. Density is probably a bit more important. Conductivity less so, since MSR's do not depend on the graphite as a decay heat path in a loss of coolant. The main difference is ThorCon needs a graphite that will resist salt intrusion at reactor pressure (6 bar).

Table 1 shows the tentative requirements. Unless stated otherwise, the properties are at room temperature.

Salt Intrusion		See below
Max Anisotropy(pct)	10	
Max boron equivalent(mass ppm)	1.0	
Minimum bulk density(kg/m3)	1800	
Target minimum length (m)	2.10	

Table 1: ThorCon Graphite Requirements

The bulk graphite will be shaped into hexagon logs approximately 300mm flat to flat and 2.1m long. Holes will be drilled lengthwise through the logs to allow salt to flow and remove heat deposited in the graphite.

Salt intrusion will be tested by taking a 5 mm thick sample from the end of each bar. The sample shall be evacuated and then submerged in mercury at a temperature no less than 20C and a pressure of at least 3.25 MPa gage for twenty hours. The sample weight gain shall be less than 3.5%. Later ThorCon will measure actual salt intrusion using a pre-fission test platform under actual conditions but with no irradiation.

Lower boron equivalent impurity will lower our fuel costs so options (and costs) for lower impurity levels are of interest.

Specifications are target values. The vendor shall state the warranted values of the above properties and the properties in Table 2. The density, thermal conductivity, and specific heat shall be characterized over a 300K to 1200K temperature range. The graphite will change shape under neutron irradiation. Changes in length are readily accomodated as long as the graphite maintains its integrity. The load on the graphite is its own weight standing vertically. We expect the graphite life will be set by when the graphite returns to its original size radially. If the vendor has data on the dimensional change as a function of fluence and temperature this would be most helpful. The graphite will be used in a demonstration reactor and the data on graphite lifetime will be gathered. We anticipate that knowledge on graphite lifetime under a neutron flux is scanty so we plan on using several graphites in the demonstration reactor to gather lifetime data on each. The target lifetime is 3e22 n/cm2 for energies greater than 50keV at 680C.

Density(kg/m3)	
Coeff of thermal exp(/K)	both ways if anisotropic
Specific Heat(J/kg-K)	
Thermal Conductivity(W/m-K)	
Resistivity($\mu\Omega m$)	
Flexural strength(MPa)	
Compressive strength(MPa)	
Tensile Strength(MPa)	
Youngs Modulus(GPa)	
Ave grain size(μm)	
Ash (ppm wt)	
Boron(ppm wt)	
Vanadium(ppm wt)	
Chlorine(ppm wt)	
Nitrogen(ppm wt)	
Sulfur(ppm wt)	

Table 2: Warranted Graphite Properties

2 Anticipated Demand

Plans call for building a pre-fission test platform in two years. Followed by construction of a demonstration plant two years later. Followed by building 3 GWe worth of power plants starting three years later. We anticipate demand to grow to a build rate of 10 GWe/year. Table 3 shows the quantity of graphite required over time. This is finished graphite after all machining.

Year	Tonnes	Facility
1	samples	Component test
2	45	Build Pre-fission test platform; Proxy measurement for salt penetration
3	0	Test Pre-fission test platform; Measure actual salt penetration
4	360	Build Demonstration plant
5	0	Test Demonstration plant
6	0	Test Demonstration plant; Measure neutron damage
7	1080	Start construction of commercial plants (1.5GWe)
9+	3600	Annual demand to support 10GWe/year deployment

Table 3: ThorCon Graphite Demand