Coolants

The ***Coolant*** used to cool the reactor in most commercial reactors today is water. In this case, the water is dual purpose since it also serves a moderating function (i.e. it slows the neutrons down to thermal energy to increase the likelihood of fission). Desirable properties for a coolant include:

- Low absorption cross section (so radiation levels produced during operation are lower)
- Abundant and Inexpensive (since so much is needed)
- Noncorrosive or low corrosivity (so the pipes and structures coming in contact with it stay intact)
- High heat transfer coefficient so that heat can be picked up by the coolant and moves elsewhere
- Low viscosity (so that not too much electrical power is needed to pump it)
- Can be kept as a liquid to high temperatures, even if it is under pressure.

Coolants that have been used, in test or commercial applications, include:

- Light (contains two atoms of hydrogen) or Heavy Water (contains one of two atoms of deuterium)
- Liquid metal (e.g. sodium, potassium, or NaK [an alloy combination of sodium and potassium])
- Liquid organics (e.g. ethanol, propane, pentane, benzene, heptane)
- Air, helium, or carbon dioxide gases

Power plants that have used nonwater coolants have included:

- EBR2 used metal coolants for over 20 years
- The French Phenix and Superphenix used liquid metal coolants for a number of years
- Public Service of Colorado's Fort Saint Vrain High Temperature Gas Cooled reactor used helium coolant.
- The Magnox and Advanced Gas Reactors in the United Kingdom use carbon dioxide gas as a coolant.

Some excellent references on coolants:

- *Coolants for Nuclear Reactors*, Rizwan Ahmed, UC Berkeley Nuclear Engineering Course paper NE 161, November 28, 1994
- *Nuclear Heat Transport*, M.M. El-Wakil, American Nuclear Society, ISBN 0-89448-014-6

- *Nuclear Reactor Engineering*, Samuel Glasstone and Alexander Sesonske, Van Nostrand Reinhold, ISBN 0-442-20057-9
