RSL Membranes™ Application and Market Sectors

1. **Oil and Gas**: Produced water or Frac Flow back water –
   a. Water reuse in the oil and gas industry or deep well disposal – use RSL membranes only.
   b. Production of pure water for irrigation or drinking water – Use RSL Membranes – with gas turbine – evaporator. This process produces pure water and a brine crystal with the lithium
2. **Pulp and Paper**: No experience with Pulp and Paper, However the RSL membrane would be used to treat water for boiler applications. Conventional drum Boilers will use RSL membranes followed by RO to make pure water. We have introduced two options which are a much lower cost
   a. RSL membrane followed by Evaporator where waste heat from a Gas Turbine used to produce electricity for process operations is used as the heat source for the Evaporator. Produces pure water for drum boiler
   b. RSL membrane only with Once Through Steam Generator Boiler (OTSG) and use of evaporator on OTSG blowdown water to produce pure water for Boiler feed. – much lower cost to produce steam than conventional Drum Boiler
3. **Mining:** Tailings ponds: RSL membranes only; process water concentration of solids with metals : RSL Membranes only
4. **Power Industry/ Chip Industry:** Pure water application: RSL membrane followed by RO or an even better solution would be similar to 1b and 2a and 2b above
5. **Descaling water**- removal of Ca, Mg, Si,: For these waters we convert the Ca and the Mg into a precipitate using NaOH and then the RSL membranes. The RSL membranes replace a clarifier and a multimedia filter in the softening process because the membranes can take high solid levels-TSS >6000 ppm in the raw water feed and operate at flux rates >250 litres per m2/hr. with 0 TSS (>0.45 micron solids) in the effluent
6. **Oil Water Separation**: RSL membrane only: Excellent opportunity for emulsified oil separation
7. **Palm Oil**: RSL membrane only: Excellent opportunity for oil separation
8. **Metal Fabrication facilities:** RSL membranes used to separate emulsified oils and solvents as well as any precipitated metals
9. **Food processing plants** where produce cleaning water needs to be treated for reuse: RSL membranes only
10. **Fried Food operations** where cooking oil needs to be cleaned for reuse: RSL membranes operate at very high temperatures (up to 600 C).
11. **Pharmaceutical:** Pure water requirements: See 1b above
12. **Beverage and Wine Industry**: RSL membranes only
13. **Poultry Farms and Pig Farms**: Not applicable
14. **Sewage (Black) Water**: Not Applicable
15. **Drinking water:** treatment of surface water (rivers, lakes): RSL membrane followed by UF membrane cartridges. We are designing these systems right now. When treating surface water, the RSL membrane does all of the filtration work and produces a UF membrane quality water. However, we add a conventional UF membrane after the RSL membrane to provide a second barrier. The UF membrane provides very little filtration because of the high quality water after the RTSL membrane. As a result we do not use a clean in place (CIP) system for the UF membrane. We allow the membrane to have a trans-membrane pressure (TMP) of 1 Bar. This takes about 6 months. When the TMP = 1 bar the UF Cartridge is removed and a new one is installed. The used UF cartridge is shipped to a central cleaning facility, such as a service provider's facility, where a CIP is provided. The cleaned UF Membrane is then sent back to the small community water treatment plant. This eliminates a complicated operating procedure for small communities. In addition it reduces the capital costs significantly. UF Membranes last much longer and operations are much simpler and more consistent.