Typical Material Selection Criteria and Questions

(Other than the first two points, these are not necessarily in order of importance or consideration)

1. **What specific service conditions, e.g., temperature, pressure, chemical environment, fluid flow rate, static or cyclic stresses, must the selected material withstand without failure? Do these defined service conditions account for possible, "worse case conditions" due to process upsets or other uncertainties?**

2. **What physical properties must the selected material meet? These may include a wide range of criteria including mechanical strength, fracture toughness, density or strength-to-weight ratio, corrosion resistance, ability to be machined, thermal or electrical conductivity, wear resistance, etc.**

3. **Have possible materials already been narrowed or dictated by applicable codes, specifications or local preferences/practices, e.g., by ASME, Mil-Specs, TEMA, ASTM, etc.? Are there good reasons for the local preferences/practices?**

4. **Specifically, what constitutes a "failure" in the particular application?**

5. **What is the minimum acceptable service life? Is this a definite requirement or an ideal result? Is the latter justified economically?**

6. **Have the most likely material failure modes in the specific application been considered, e.g., fatigue, wear or corrosion? Are there other factors besides the material selected that may greatly affect overall reliability, e.g., quality of the design, quality of the fabrication, difficulties in on-site installation, difficulties in completing maintenance once in use, etc. ? Has a <u>systems approach</u> been employed in assessing the application or is there attention only on the material?**

7. **Are periodic replacements of the material or component practical? If so, is this approach acceptable for other reasons?**

8. **Is it possible or desirable to use a non-metallic material?**

9. **Is weldability an issue? If the selected alloy can be welded but special skills or precautions are needed, are in-house personnel or contract personnel available that can be depended on for satisfactory results?**

10. **In known corrosive service conditions, are alternative corrosion control measures practical? For example – Can a suitable coating be used? – Can a corrosion resistant alloy clad to a carbon steel substrate be used rather than solid plate of the more expensive alloy? – Is use of a suitable chemical corrosion inhibitor possible in the application? – Does the application permit use of cathodic protection for corrosion control?**

11. **What are the economic consequences of a "failure" of the part or component? For example, will a failure be inconvenient but have little effect on the overall process OR will the entire, continuous manufacturing process have to be shutdown if the component fails? What is the cost per time period if the latter is true? Have lost-production costs been as well defined as the initial costs of alternative materials? Will a failure result in a severe safety hazard?**

12. **Is carrying a pre-fabricated spare in inventory practical and justified based on the cost of a failure? Is it practical to carry only the needed but long-delivery-time material in inventory and then do the fabrication when or if a failure occurs?**

13. **In view of other considerations, will the initial material cost alone govern the selection decision OR will the true life-cycle costs of using the alternative materials be used in making the decision?**