**LSST REFRIGERATION ARTICLE Draft Version 3.0**

**Possible Authors:** Rafe H. Schindler, Gordon Bowden, Yongqiang (Brian) Qiu, Boyd Bowdish, Diane Hascall, Margaux Lopez, Thomas Markiewicz, John Ku, J. Brian Langton, Nadine Kurita, Mark Freytag, David Shelley, Stuart Marshall

**Outline:**

1. **Overview: Lead author Rafe [1 to 2 pages and 3 figures]**
   1. Refrigeration and Facility Requirements [Rafe]
   2. Discussion of Technology Drivers and Cooling Options [Gordon]
   3. Architecture and Thermal Design of the Cryostat. [Gordon]
   4. Architecture of the Cold and Cryogenic Refrigeration Systems [Rafe]
      1. TMA and I&T
2. **Cryogenic Mixed-Refrigerant System Lead author Rafe [10 pages and 6- 8 figures]** 
   1. Overview of system (major components)[Rafe]
   2. Thermodynamics of mixed refrigerants [Bowden]
   3. Mixed Refrigerant Development [Rafe]
   4. System Components (incl. Assembly and Testing) [Brian/Rafe]
      1. Compressor Chassis
      2. Transfer Line System Incl. Cabinets
      3. HeX System Design
      4. Cryoplate Design
      5. Instrumentation, Control and Monitoring
      6. Operational issues(oil, moisture, particulates, etc.)
3. **Cold Azeotropic-Refrigerant System Lead author Brian [5 pages 6-8 figures]**
   1. Overview of system (major components)
   2. Thermodynamics of R507A refrigerant
   3. Cold Refrigeration System Development
   4. System Components
      1. Compressor Chassis
      2. Transfer Line System Incl. Cabinets
      3. HeX System Design
      4. Coldplate Design
      5. Instrumentation, Control and Monitoring
      6. Operational Issues (oil, moisture, particulates, etc.)
4. **Performance of the Systems Lead author Brian [8 pages, 4 figures]**
   1. R&D system’s performance(only text}
      1. Cryogenic
      2. Cold
   2. I&T system
   3. TMA system
   4. Maintenance and Lifetimes (expectations)