

**NSF Presentation -
Subcontracts for
Damped Metal Spring Fabrication**

S. Whitcomb

9 June 1998

**Procurement Sensitive Document-
Do Not Distribute**

Damped Metal Springs: Background

- **Initial Hytec contract (1995) with LIGO to explore damped metal spring concepts for possible inclusion in LIGO**
- **Contacted approximately 20 companies with coil-forming equipment and experience**
 - ›› Only Pegasus responded positively
 - ›› Unusual combination of production techniques
- **Prototypes fabricated and tested 1996-7**
 - ›› Hollow phosphor-bronze tube with damping structures epoxied into center volume
- **Based on satisfactory prototype test results, decision made to adopt coil spring in LIGO Seismic Isolation System**
- **First article contract awarded to Pegasus in Fall 1997**

Damped Metal Springs: Current Contract

- **First Article contract with Pegasus**

- ›› 450 springs at \$138 each (compared with Hytec estimate of \$350 each)
- ›› Production tooling and fixturing
- ›› Total contract value

- **Pegasus responsible for complete fabrication**

- ›› Except long-lead materials supplied by LIGO (first article only)
- ›› Included subcontracts with KTI for electron-beam welding of end caps and with Helium Leak Test for helium bomb leak testing

- **Production cost estimate (\$106 each + helium leak test costs) significantly lower than initial Hytec estimate (\$250 each)**

Damped Metal Springs: Experience

- **Approximately 100 First Article springs tested to date**
 - ›› All have passed helium leak test
 - ›› Meet requirements for spring constant and damping
 - ›› Reproducibility seems to be improving
- **First Article fabrication more difficult than expected by Pegasus**
 - ›› Epoxy dispenser purchased to make fabrication easier
 - ›› Set-up time, clean-up time significantly longer than expected
 - ›› Has required approximately twice as much manpower as initially estimated
 - ››

Damped Metal Springs: Solicitation

- **Pegasus asked to be relieved of responsibility for end cap welding and helium leak testing in full production phase**
 - ›› Springs do not return to Pegasus after welding and testing
 - ›› Difficult to manage scheduling and technical supervision
 - ›› LIGO accepted this request
- **KTI offered to take responsibility for both final steps**
- **Pegasus quote for springs with epoxy more than double earlier production estimate**
 - ›› Prototype springs fabricated without epoxy as possible cost saving measure
 - Testing underway
 - ›› May be suitable in many locations

Damped Metal Springs: Proposed Coiling Contract

- **Pegasus responsible only for coil fabrication**
- **Firm Fixed price for each of 2 types:**
 - ››With epoxy: \$199
 - ››Without epoxy: \$117
- **Order for 3000 springs**
 - ››Nominal quantities: 2000 without epoxy, 1000 with epoxy
 - ››May adjust numbers based on additional spring testing (in progress)
- **Change order for long-lead materials already placed**
 - ››Needed to maintain schedule
 - ››Added 20 additional springs without epoxy to permit further testing

Damped Metal Springs: Proposed Welding Contract

- **KTI initially selected by Pegasus/Hytec based on demonstrated capabilities, price and proximity to Pegasus**
- **All weld and leak test techniques developed and proven on first article production run**
 - ››LIGO staff have made multiple visits to KTI and Helium Leak Test to witness fabrication and testing
- **KTI scope of work**
 - ››Machine coils to length and fabricate end caps
 - ››Electron-beam weld end caps to coils
 - ››Helium bomb leak test
- **Firm Fixed Price contract for 3000 springs at \$42.65 each**
 - ››Tooling costs of \$6200

Summary

- **Pegasus contract**

- ›› Excellent performance by a motivated contractor
- ›› Fixed prices for springs with and without epoxy allows LIGO to optimize cost and performance
- ›› Critical to meet installation schedule

- **KTI contract**

- ›› Continues with successful first article subcontractors
- ›› Takes maximum advantage of development to date
- ›› Price is favorable to LIGO considering nature of work

- **Total cost (Pegasus + KTI) will be between \$500k and \$750k, compared with budget of \$750k**