BUILDING A SUCCESSFUL BUSINESS IN SUPERCONDUCTIVITY
7/24/00

I. TITLE SLIDE – NTRODUCTION — VG – 1

A. Trepidation

1. Trepidation - talking to an academic audience
2. Will talk about QD's products and experiences
3. Not a technical talk – sit back and enjoy

B. Talk Will Address More Of Business Issues

1. How we started – an early project
2. How to decide what makes good products
3. What they don't teach you in graduate school

II. INTRODUCTION TO QUANTUM DESIGN

A. The Quantum Way – Our Bias — VG – 2

1. Toward Small Companies
   Worked in large organizations – I didn't like it
2. Against Venture Capital & Public Offerings
   Bridle and saddle
   Quarterly board meetings to explain missing your targets
3. There are other ways to be successful
   I only know how we have done it
   18 years in business - made a profit 17 of those years

B. Founders of Quantum Design — VG – 3

1. Mike Simmonds – Ph.D., Research & Product Development
2. Ron Sager – Ph.D., Research & Product Development
   a. UC San Diego, Prof. John Wheatley
   b. SQUID development, Superfluid He-3
3. Barry Lindgren – B.S., Sales, management, admin.
4. Dave Cox – B.S. Cryogenic(Video) Engineer

III. WHY WE STARTED QUANTUM DESIGN — VG – 4

A. Founders were all employees of SHE Corporation

1. Life was not "fun" at SHE
2. SHE was over-staffed and losing money
3. Small companies losing money aren't much fun

B. General "Rules of Thumb" for small companies

1. $100K - $140K per man-year
2. 2 – 3 month cash/credit reserve (based on revenues)
3. Debt-to-Equity Ration (< 1)
4. Prompt Payment of Payables

C. SHE Corporation circa 1982

1. Overstaffed ($3.5M Revenue/105 Employees)
2. Payables > 90 Days
3. Generally – Bad Management Decisions

IV. QUANTUM DESIGN – DAY 1 **VG – 5**

A. Assets: 1 Bay, 4 Keys, $8,000 & 4 Warm Bodies

B. Liabilities: One $15,000 3-year lease

C. First Bay For Quantum Design **Slides**

V. NOW WHAT WE DO?

A. Announce that you are in business

B. Quantum Design – Our First Communication **VG – 7**

C. Quantum Design – How We Felt **VG – 6**

VI. HUNTER GEOPHYSICS – FIRST MAJOR PROJECT

A. "FRACING" A Gas Well – Mapping the Fracture **VG – 8**

1. Hunter Geophysics – small company in San Jose
2. Funding from the Gas Research Institute
3. Well is small round hole with gas in rock pores
4. Tight gas sands – low permeability rock formations
5. Increase surface area for gas diffusion to well head
6. Rock fractures along the grain of the rock
7. Pump hydraulic fluid with propant into the well & crack
8. Kilometers long, several kilometers deep, few mm wide
9. Volumetrically – 60,000 gallons at 50,000 psi
10. Use SQUID sensors to map the direction and extent
11. Drill additional wells according to fractures
12. Normal method – tiltmeters
13. Hunter Project – Map the fracture with tiltmeters

B. Geography of Experiment

1. Society of Petroleum Engineers – (Mar 14-16, 1983) **VG – 9**
2. Geographical – Wellhead, Pumping Trucks, Sensors **VG – 10**
3. SQUID Sensors
   a. 3-Axis Geophysical Magnetometers
   b. 2-Axis cryogenic Tiltmeters

C. Raw Data Plots **VG – 11**

1. Background magnetic field from the earth
2. Tilt in earth's magentic field during the fracture
3. Subtract background to get residual magnetic signal

D. Data From The Fracture **VG – 12**

1. Theoretical tilt vector map: vertical & horizontal fracture
2. Actual tilt vector map: two phases of fracture
3. Magnetic profiles for a horizontal fracture
4. Three stages fracture formation

E. Experimental Results

1. Formation of the Fracture – 2 Stages **VG – 13**
2. Magnetic signals from the fracture event **VG – 14**

F. Catoosa II Site Photos

1. Magnetometer installation site **VG – 15**

   Imagine using SQUIDs in a cow pasture
   Cows dragging your cables
   Other things best left undescribed

2. Magnetometer installation hole – steel balls **VG – 16**

   Rock at Catoosa – used steel balls to drill holes
   Freezing rain falling on your electronics
   1)

3. Well head site – overflow pit **VG – 17**

   Environmentally insensitive
   60,000 gallons of hydraulic fluid

G. References to "Losing a Crew"

1. Possibility of a rupture at the well head
2. Crack collapses ejecting 60,000 gal of hydraulic fluid
3. Fracture acts as an atomizer
4. If one spark occurs, you "Lose a crew"

VII. WHAT SHOULD WE DO NOW? **Slides**

A. Magnetometers For Oil Exploration – Not a Product

1. This is the kind of project in which one can get involved
2. Even successful measurements don't make a product
3. Could detect the fractures near the surface (but not at 1 km depth)
4. Disadvantages of using cryogenic equipment (cost to benefit ratio)

B. Room Temperature Magnetic Measurements

C. Ronald Reagan & Star Wars – Particle Beam Accelerators

D. Some Of Us Were Getting A Bit Weird

VIII. MPMS – THE FIRST MAJOR PRODUCT

A. Research Company? or Product Company?

B. Are Geophysical Magnetometers A Product?

C. What Makes A Good Product? **VG –1 8**

IX. DEFINING A "GOOD" PRODUCT (FOR A COMPANY)

A. What Makes A Good Product? **VG – 19**

1. Many people want to buy it
2. You can sell it for more than it costs

B. Why Do People Want To Buy It? **VG – 20**

1. Cost is Commensurate With Benefit
2. Helps Make or Save Money (medical equipment)
3. Solves a Problem (MRI, Microwave oven, MPMS)
4. Provides Convenience (dishwasher)
5. Personal Enjoyment (television)
6. Good Economics

C. What Makes A Good Instrument? **VG – 21**

1. Performs A Needed Measurement
2. Easy To Use
3. Reliable
4. Well-Supported By Manufacturer

D. Commercial Encounters Of The **VG – 22**

1. First Kind – Build One For the Government
2. Second Kind – Sell a couple to your friends
3. Third Kind – Manufacture Dozens With Documentation
4. Mark I – Was of the Second Kind
5. Serial #1 – Eventually became of the Third Kind

E. For A Commercial Product **VG – 23**

1. Engineered For Manufacturing and Testing
2. Manufacturing Process is Documented
3. Intuitive and Forgiving For Wide Range of Users
4. Professional Service and Support
5. Useful enough to buy with your own money

X. WHAT QUANTUM DESIGN IS ALL ABOUT VG – 24

A. Quantum Design's Goals

1. Keep Your Customers Happy
2. Make A Profit
3. Create An Enjoyable Place To Work

B. Factors That Have Contributed To Our Success **VG – 25**

1. Good Products
2. Good Service
3. Good Financial Management
4. Good Personnel Management

XI. THERMAL MANAGEMENT WORKSHOP VG – 26

A. Primarily Focused On Semiconductor Industry

1. University of Minnesota – October 1995
2. Grew out Semiconductor Roadmap
   a. Technology needs through 2007
   b. Thermal management is big problem

3. I represented the Superconductor Industry
4. Think of me as the comic relief
5. Cryogenics can solve the thermal problem

D. 1995 – Technology Push Versus Technology Pull **VG – 37**

1. Most significant slide presented at Cryocooler Conference
2. Presented by an Army Captain – Army not funding High-T_c
3. No matter how hard – 2-6 years to products
4. No matter how easy – 10 years to products