Offshore energy harvesting

1. Introduction: Aim (Goal)

Find the best/required energy harvesting system for offshore locations

What type of locations (oil rigs: do we restrict our selves to dead rigs? What about functioning ones?)

How far offshore?

Necessary power for basic functions

How many locations? (Addresses impact and final benefit to company/country/world)

Define best (requirements)

1. Delivers necessary power
    - Absorbs variable energy supply and demand
2. Most economical
    - Manufacturing (implies simple?)
    - Delivery/Start-up
    - Maintenance (implies reliable?)
    - Shut-down/retrieval/disposal
3. Environmentally friendly

What if system is able to produce more power than necessary?

- More issues raised: storage and delivery of excess power
- Is this a worthwhile aim?

Secondary (?) goal: microscale energy harvesting for sensors on fish

2. Motive/Needs (Why do this?)

Importance of application

Required energy

Cost justification

Current solution is bad (define); no existing alternatives (maybe one-UK system?)

Public image

Political reasons

Environmental benefits

Importance of fundamental research

Education benefits

Advancement of fields

Possible future applications

3. System diagram, definitions, metrics

System diagram explains energy transfer

Metrics: power/energy density (power/energy per volume), specific power/energy (power/energy per mass), efficiency

4. Means/Opportunity

Natural energy sources; theoretical calculation of available energy

Theoretical approach to reality: back-of-the-envelope (zeroth-order) analysis shows order of magnitude numbers; fluid to mechanical, mechanical to fluid storage, mechanical to electrical, electrical storage, other storage

Experimental approach to reality: existing technology, development trends (foreshadow or quote background to be presented in next section)

Both approaches converge to the goal requirements

5. Background

Existing technology shows feasibility of concept and places the requirements in context (are we requiring a lot or little energy? Is this problem easy or hard? What parts are hard? Why?)

6. Scope (What issues do we intend to address)

Fundamental theoretical bounds

Reliability issues

Failure modes: corrosion, fatigue, others

Energy fluctuations; power averaging or “smoothing” over time

Design of oscillating harvester

Oscillating vs. rotary design

Overall cost: manufacturing, maintenance (including trip to offshore location: how often is a dead rig visited for any other reason?)

7. Qualifications/Means (How are we doing this? What makes us qualified?)

Personnel: faculty and researchers, students (graduate and undergraduate)

Facilities

- MIT: Alex's lab, machine shops (water jet cutter), MTL (fabrication), Alex's network/Athena
- Olin: Machine shop (water jet and laser cutter), computing facilities
- Massachusetts Maritime Academy: test location?

8. Timeline (Gantt chart?)

9. Deliverables

Framing of problem

Identification of relevant issues

Technology selection

Conceptual design

System design

Detail design

- Electromechanical transducer
- Mechanical system
- Energy storage

10. Extension of research

11. Budget

12. Conclusion

13. References