Table 1A: Ultra-Deepwater Offshore Technology Systems Application Roadmap

		2001	2002	2003	2004	2005	2006
High Intensity Design	**New Systems Architecture**	Definition, Evaluation, and Concept Selection ▼◆▲✪+●❍■❑	Develop Interface Definition & System Level Decision Rules ▼◆▲✪+●❍■❑	Publish Open Architecture Definition ▼◆▲✪+●❍■❑			
	High Intensity Design Engine	Conceptual Flow Sheets & Fast Productivity Index ▼+❑	Software to Host System Configuration ▼+❑	Develop System Optimization Computational Mathematics & Hardware ▼+❑	Comprehensive Virtual System Optimization & Visualization Prototype ▼+❑	Pilot Application for Specific Ultra-Deepwater Field Development ▼+❑	
	Component Optimization Modules	Critical Components Identification ▼	Virtual Component Module Prototype for 3 Core Subsystems ▼◆▲●❑	Virtual Component Module Prototype for 3 Additional Core Subsystems ▼✪+❍□	Virtual Component Module Prototype for 3 Additional Subsystems ▼■✳	Virtual Component Module Prototype for 3 Additional Subsystems ✳▼✪	
Accelerated Reservoir Exploitation	**Reservoir Property Verification**		Low Cost Micro Drilling Self Contained Fluid/Rock Sample Retrieval System ▲●❍◆	Alternative Subsalt Remote Sensing & Imaging Technology ◆▲✳	Final Reservoir Exploitation Design ▼◆▲●✳		
	Subsea Gathering Systems	Systems Definition and Early Design ▼◆▲●❍	Low Volume System Lab & Field Trials ▼◆▲●❍	High Capacity System Design and Component Testing ▼◆▲●❍□	Offshore Shelf Well Field Trials ▼◆▲●❍	Ultra-Deepwater Field Trials ▼◆▲●❍	
	Reservoir Monitoring and Control	Systems Definition and Early Design ▼◆▲□	Low Volume System Lab & Field Trials Plus Seismic Fluid Movement Monitoring ▼◆▲□	High Capacity System Design and Component Testing with Adjustable Learning Completion Capability ▼◆▲✪	Offshore Shelf Well Field Trials ▼◆▲□	Ultra-Deepwater Field Trials ▼◆▲	
Rigs/Reach/Riserless	**Riserless Drilling Systems**	Conceptual Engineering and System Architecture ◆▲✪●❍	Critical Component Development and Testing ◆▲✪●❍□	System Integration and Alpha Testing ◆▲✪●❍□	Shallow Water Trials ◆▲✪●❍	Deepwater Trials ◆▲✪●❍	
	System Integration While Drilling	System Concept Development Plus Materials & Placement Research ◆▲✪●❍	System Architecture Definition & Component Design/Testing ◆▲✪●❍□	System Integration and Alpha Testing ◆▲✪●❍□	Field Trials ◆▲✪●❍		
	High Capacity Production Wells		System Architecture ◆▲●❍□	Critical Component Design & Testing ◆▲●❍□	Field Trials ◆▲●❍		
	Intervention Systems	Conceptual Engineering & System Architecture ▼◆▲●	Remote Controlled Light Duty Intervention Robot ▼◆▲●	AUV Service Vessel Intervention Delivery ▼◆▲●	Remote Controlled Micro-Drilling and Workover ▼◆▲●	Fracturing and Cementing AUVs ▼◆▲●	First Time Field Demonstrations ▼◆▲●
Energy to Market	**Subsea Processing & Flow Assurance**	Acoustic Liquefaction, Membrane Separation, & Hydrate Formation/ Transport Research ◆▲✪+■❑	Subsea Processing Architecture & Interface Definition ◆▲✪+■❑	Critical Component Design & Testing ◆▲✪+■❑	System Integration & Testing ◆▲✪+■❑	Offshore Shelf Well Field Trails ◆▲✪+■❑	Ultra-Deepwater Field Trials ◆▲✪+■❑
	Hydrocarbons to Clean Fuel, Feedstock, Products	Research Interface with Clean Fuels Roadmap +■❑✳	Conceptual Engineering & System Architecture +■❑✳□	Critical Component Development and Testing +■❑✳□	System Integration & Testing +■❑✳□	Offshore Shelf Well Field Trails +■❑✳□	Ultra-Deepwater Field Trials +■❑✳
	Offshore Power Generation/Transmission	Superconducting Electric Transmission Pipeline Research +✳✳	Superconducting Electric Transmission Pipeline Research +✳✳□	Conceptual Engineering & System Architecture +✳✳□	Critical Component Development and Testing +✳✳	Critical Component Development and Testing +✳✳	System Integration & Alpha Testing +✳✳
Environmental Management	**Greenhouse Gas Sequestration**	See Greenhouse Gas Sequestration Roadmap					
	Well Control with Near Zero Spill Volume	Sensor Research for Early Detection of Loss of Well Control ▲✪■	System Development for Point-of-Loss Fluid Capture ▲✪■	Detailed Design and Model Testing ▲✪■	Prototype System Testing ▲✪■	Offshore Shelf Well Field Trials ▲✪■	Ultra-Deepwater Field Trials ▲✪■

Table 1B: Ultra-Deepwater New Technology

Advanced Reservoir Decisionmaking	deeplook direct reservoir flow variable measurement	advanced semi-analytical methods	new solvers for massive number of equations	geographical corroboration of solution	
Remote Power Supply Systems	high capacity transmission methods	downhole fuel cells	ROV / AUV / robotics power	in-situ power generation using native (reservoir) fluids	catalysis techniques for high pressure fuel cells using native fluids
Subsea/subsurface communications	reliable wet-connect electrical system	wireless methods	filtering and transmitting acoustic signals for optimum couping	acoustic interbranch communication	
Materials	advanced composites	non-metallic materials	new fabrication technology	adjustable property surface coatings	
Seafloor Chemical Process Engineering	subsurface adaptation of GTL technology	high pressure fuel cells	micro-reactors for generation of chemicals and fuels	subsea product trains	
Remote Control Drilling	micro drilling	rig mechanization, modular tool set & robotics	remote mud package	convertible drill mud	reservoir fluid sampling and analysis
Wellbore Stabilization Methods	expandable tubulars	casing-while-drilling systems	cementing while drilling	adjustable and reversible pore throat permeability control with cementation	rock fusion
Simultaneous Transport Phenomena	low-temp solid-liquid equilibria/vapor-liquid equilibria	complex deposition, hydrates, scales, organic solids, & particles	momentum, heat, & mass transfer under general flow conditions		
Subsalt Imaging	advanced seismic methods	emerging non-seismic methods			
Advanced Separations	compact seafloor / downhole separators	methane permeable membranes for gas upgrading	ceramic membranes	seafloor water conditioning for injection	
Superconducting Long Distance Transmission	high capacity bundling	subsea packaging and installation methods	remote underwater splicing technology		
Carbon Waste Disposal	new product stream definition and material conversion process	geologic sequestration	waste disposal methods		