Brief History of the Oak Ridge National Laboratory

<u>Beginnings</u>

- The WWII Manhatten Project was the beginning for most of the national laboratories

- ORNL was established (as "Clinton Laboratories") in 1943 as a pilot plant for production and chemical recovery of plutonium

- The concept of the national laboratories was proposed
  - — Because of recognized scientific strength of the wartime nuclear research facilities
  - — Purpose: to continue nuclear R&D; to conduct unclassified fundamental research too "big" for a single university or industry

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Brief History of the Oak Ridge National Laboratory

Peaceful Use of Atomic Energy

- In 1948 Clinton Labs renamed the Oak Ridge National Laboratory
  - — Basic research
  - — Chemical technology
  - — Isotope production and research
  - — Chemical technology role in reactor development
- Mission: develop safe, economical production of nuclear power
- ORNL became the center for radioisotope and research
- The Biology Division started under directorship of Dr. Alexander Hollaender
- Physical sciences programs broadened to support development work
- In 1940s ORNL built, tested, and expanded the technological and scientific base for pratical nuclear energy production

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Brief History of the Oak Ridge National Laboratory

1950s - Role expanding

- Nuclear power demonstrated — ORNL built a nuclear reactor for exhibition at the 1st UN International Conference for Peaceful Uses of Atomic Energy in 1955

- ORNL began to explore fusion — the Thermonuclear Experimental Division formed in 1957

- The Ecological Science Section formed in 1956 to investigate the effects of radioactivity on bacteria, fungi, mites and insects

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Brief History of the Oak Ridge National Laboratory

1960s - Some New Areas

- Nuclear reactor safety work expanded
- Breeder reactor programs — molten-salt breeder reactor
- ORNL began work for other Federal agencies (than the Atomic Energy Commission, a predecessor of DOE)
  - — NASA
  - — Interior
  - — NIH
  - — NSF
  - — EPA
- ORNL's environmental program expanded
- ORNL hired its first social scientists

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Brief History of the Oak Ridge National Laboratory

1970s - A National Energy Laboratory

- ORNL expanded into more nonnuclear areas
  - — Energy conservation
  - — Materials resources and recycling
  - — Environmental indices
  - — Regional modeling
  - — Began work of EIS in 1971
- The Energy Division was formed in 1974
- The Energy Research and Development Administration replaced AEC
- ORNL roles for ERDA were in developing new energy technologies

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Brief History of the Oak Ridge National Laboratory

1980s

- ORNL is now the largest DOE multiprogram energy laboratory
- One of ORNL's current challenges is to apply its R&D resources to improve our national competitiveness
- ES&H upgrade is foremost on DOE, Energy Systems, and ORNL's minds
- ORNL is becoming more and more of a National and international R&D laboratory
  - — Over 2300 guests at the Lab this year
  - — Several collaborative centers and user facilities
  - — Education role has expanded to precollege

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Since its beginning, ORNL has made outstanding contributions in sciences and engineering related to the safe, economic production and use of energy

A sampling of past accomplishments include:

- Development of techniques for estimating radiation doses to humans (used worldwide)
- Development of advanced centrifuge for producing vaccines and rapid medical diagnoses (used commercially)
- Initiation of radionuclide production and development of radiopharmaceuticals (used extensively in field of medicine)
- Founded the field of heavy-ion physics
- Pioneering of neutral injection plasma heating for fusion devices
- Development of instrumentation for monitoring carcinogens produced in coal conversion processes

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A Sampling of Past Accomplishments (continued)

A sampling of past accomplishments include:

- Pioneered and developed the technique of neutron activation analysis
- Invented resonance ionization spectroscopy and demonstrated its usefulness to identify and count atoms one at a time
- Discovered the technique for maintenance of frozen embryos and vital organs
- Discovered sex determining mechanism in mammals and establishment that only one x chromosome is active
- Developed neutral beam plasma heating (fusion). Now used worldwide on tokamak devices
- And many more

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Martin Marietta Energy Systems, Inc.

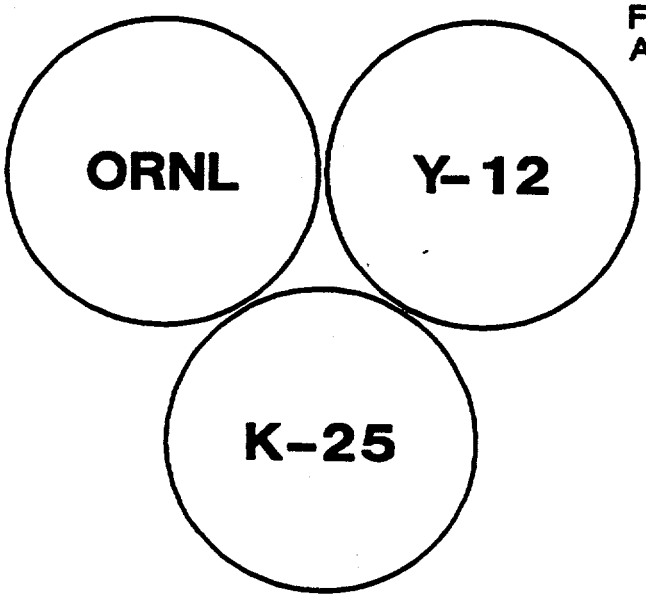
Conducts

Applied R & D in

- Fusion
- Fission
- Conservation
- Fossil
- Other

Basic Research in

- Physics
- Life Sciences



Processes, Fabricates, and Assembles

- High Quality Weapons Components

Operates Enrichment Facilities

Develops Enrichment Technologies

ORNL-16951

Oak Ridge National Laboratory
Largest DOE Multiprogram Laboratory

Conducts:
Applied Research & Engineering Development in

Fission Energy Fusion Energy
Fossil Energy
Conservation & Renewable Energy
Other Energy Technologies

Performs:
Basic Scientific Research in
Physical Sciences
Life Sciences

882-16962

Fission Energy Programs at ORNL

Support DOE's Civilian Nuclear Power Program through R & D on

Nuclear Fuel Reprocessing

High-Temperature, Gas-Cooled Reactors

Instrumentation & Controls

Nuclear & Chemical Wastes and Materials

782-16963

Fusion Energy Programs at ORNL

Are Making Major International Contributions
in

Stellarator Confinement Configurations
Plasma Heating
Fueling Systems
Superconducting Magnets
First-Wall & Blanket Materials
Applied Plasma Physics

882-16961

Conservation/Renewable Energy at ORNL

Has Programmatic emphasis in:

Applications of High-Temperature Materials
Electric Power Distribution Systems

Conservation Technologies
for
Buildings & Industry

Biomass Production
Energy Storage

882-1696U

Fossil Energy Programs at ORNL

Concentrate Primarily on

Materials Research & Development

and

Coal Conversion And Utilization

18-10960

Basic Physical Sciences Programs at ORNL

Includes Major Thrusts in the Fields of

High Temperature Materials
Neutron Scattering
Surface Physics
Aqueous Separations
Analytical & Environmental Chemistry
Robotics
Parallel Computing
Heavy Ion Physics

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Biomedical & Environmental Programs at ORNL

Emphasize

The Interaction of

Energy-related Physical & Chemical Agents

with the

Environment & Living Organisms

S32-16966

Other R & D Programs at ORNL

Are Diverse & Extensive:

Hazardous Waste R&D

Space & Defense Technologies

Artificial Intelligence

Parallel Computing

Data Systems R&D

882-16971

User Facilities

Atomic Physics EN Tandem Accelerator
Bioprocessing Research Facility
Health Physics Research Reactor
High-Temperature Materials Laboratory
Holifield Heavy Ion Research Facility
Low-Temperature Neutron Irradiation Facility
National Center/Small-Angle Scattering Research
Neutron Scattering Facility
Oak Ridge Electron Linear Accelerator
Oak Ridge Environmental Research Park
Roof Test Facility
Shared Research Equipment Collaborative Research Program

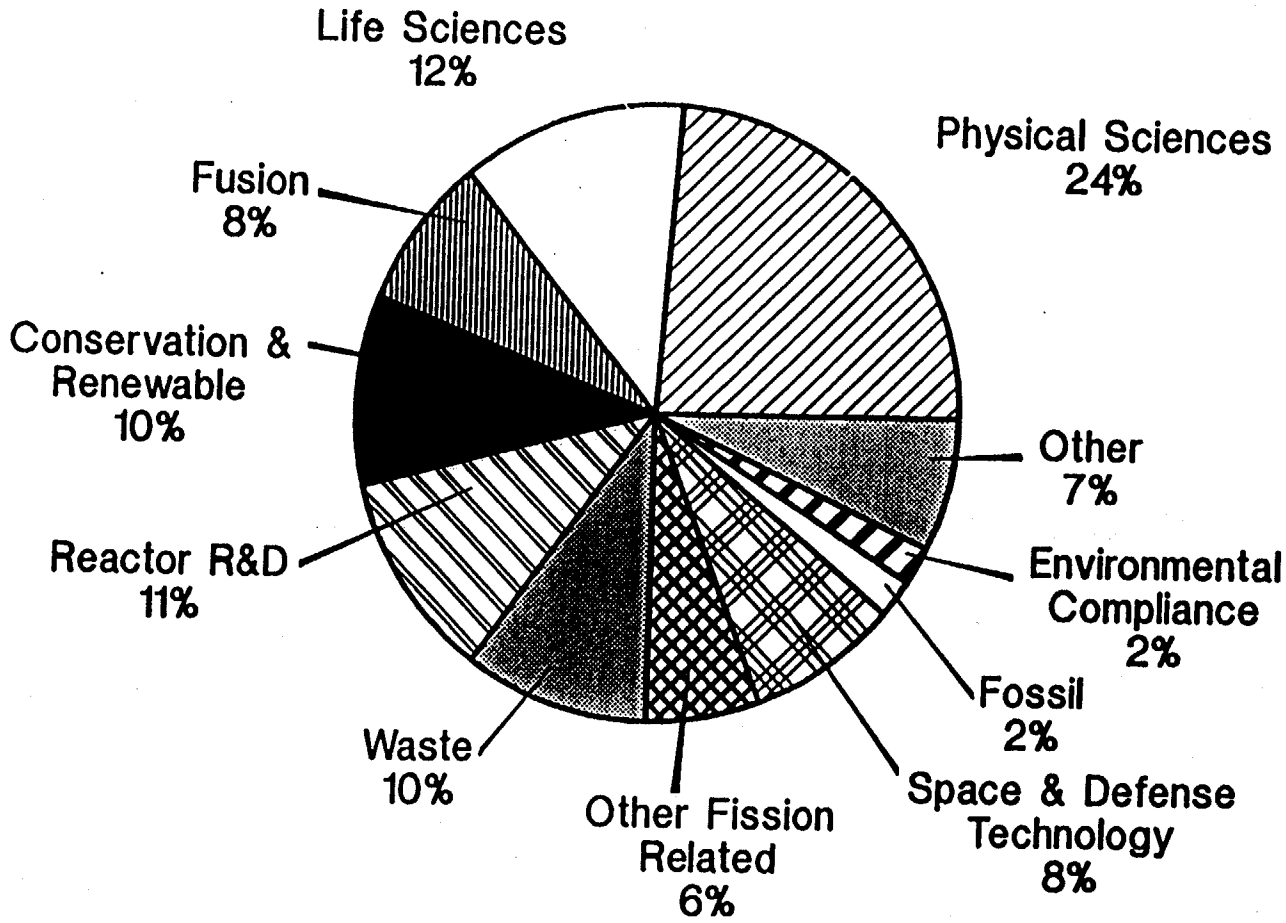
Surface Modification and Characterization
Collaborative Research Center

882-16972

Work for Others
Sponsors at ORNL Include

Department of Defense
Department of Transportation
Department of the Treasury
Electric Power Research Institute
Nuclear Regulatory Commission
Environmental Protection Agency
Dept. of Health & Human Services
National Science Foundation
Federal Emergency Management Agency
and
50+ Other Federal and Non Federal Sponsors

ORNL's Program Areas



1989 Operating BA
$457 Million

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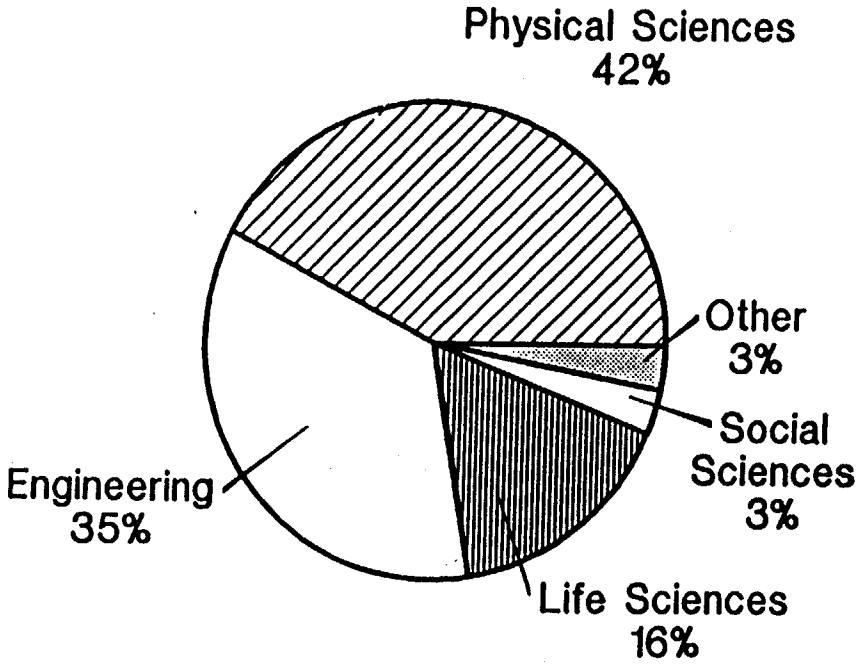
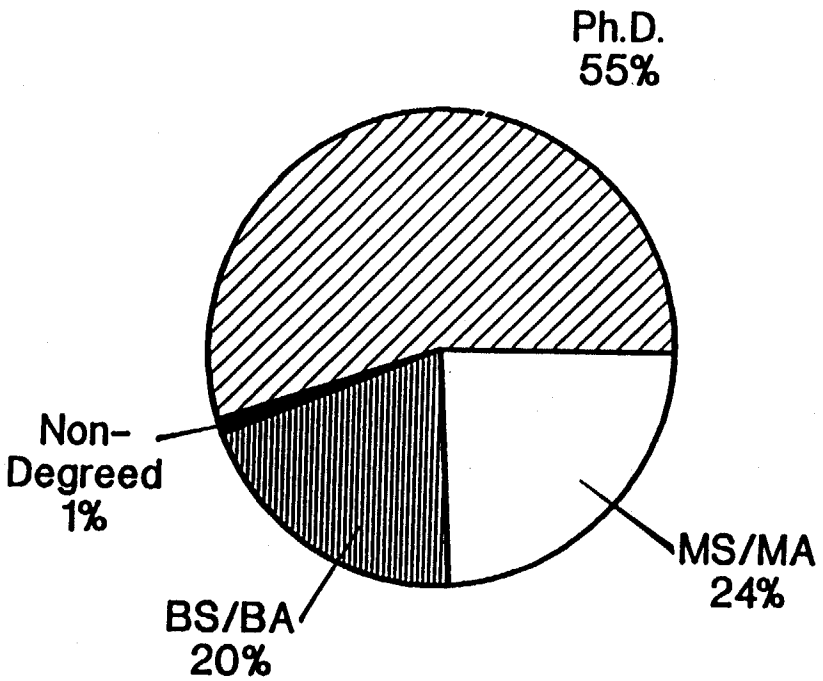
ORNL's R&D Staff



By Discipline



By Degree

1552 Professionals in R&D Divisions
(as of December 31, 1988)

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Scientific And Technical Highlights

Advanced Energy Systems

- ATF accessed second stability region
- ORNL triple effect absorption chiller licensed to Trane with GRI financing
  - 50% more efficient
  - A multibillion dollar worldwide market could result
- Development of ductile iron aluminides
  - Room temperature ductilities up to 22%
  - Outstanding corrosion resistance (e.g., in sulfidizing environments)
  - Claudette McKamey named Energy Systems "Inventor of Year"
- Record productivity of poplar plantation (biomass production) Achieved by University of Washington (43 Mg/Ha/yr)
- Castable alloy of Ni_3Al developed at ORNL yields superior results
  - Armco
  - Cummins with precision cast parts

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Scientific And Technical Highlights

Nuclear and Engineering Technologies

- Loss-of-coolant-accident experiment at AVR gas-cooled reactor (Germany) demonstrated inherent safety features of MHTGR
- A study of the integrity of commercial PWR pressure vessel supports concluded that concern over embrittlement in certain PWRs may be warranted
- Treatment with potassium cobalt hexacyanoferrate (II) has been shown effective in removing cesium from process waste water
- The first fission product release test conducted in a hydrogen atmosphere at 2700 K yielded information on fission product and fuel meltdown behavior
- True diamond films and coatings - with hardness comparable to that of natural diamond - were developed for use in optics program components

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Scientific And Technical Highlights

Physical Sciences

- The HHIRF tandem electrostatic particle accelerator established a new record for terminal voltage potential in a tandem accelerator - 25.5 MV
- A new imaging method for obtaining chemically sensitive atomic resolution images of semiconductor interfaces was developed using a Z-contrast imaging technique and a high resolution scanning transmission electron microscope
- A new crystalline substrate for the formation of epitaxial thin films of high temperature superconductors was discovered. Potassium tantalate can be produced at lower cost and in larger sizes than previously used substrates
- Analytical models have been derived for zirconia ceramics correlating the effect of internal grain size on various parameters that can trigger transformation to a more resilient structure
- Four ORNL groups are performing "cold fusion" experiments, examining a number of novel approaches. Several experiments found as yet unexplained effects including neutron excesses and a power imbalance

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Scientific And Technical Highlights

Life Sciences

- First royalty-bearing license for a nuclear medicine technology developed at ORNL granted to E.I. du Pont de Nemours
- Protein engineering at ORNL reveals the mechanistic details of the CO_2-fixation enzyme (a major determinant of biomass yields and global CO_2 levels)
- A human DNA repair gene, the cDNA of the human methyltransferase, was successfully cloned using in vivo complementation
- Biology Division's genetic, functional, and molecular mapping of specific regions in the mouse genome is a major component in molecular mapping strategies in the human genome
- 20 years of ecological research synthesized for publication of "Analysis on Biogeochemical Cycling Processes in Walker Branch Watershed" - one of the few long-term, intensive ecosystem studies in the U.S.

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ORNL Is Proposing These New Laboratory Initiatives

- Advanced Research Center for Materials Science and Engineering
- High Energy Physics Research and Detector Development Center
- Gammasphere
- Grand Challenges in Computational Science
- Multifaceted Research, Development and Demonstration Program in Hazardous Waste Management
- Modernization of the Isotopes Program
- Life Sciences Complex

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Other New Initiatives Include:

- Center for Mathematical Environmental Modeling
- Structural Biology
- Human Health Risk Analysis
- Energy Technologies for Developing Nations

ORNL Has Several Continuing Initiatives

- Advanced Neutron Source
- Heavy-Ion Storage Ring for Atomic Physics
- High-Temperature Superconductor Research and Development
- Microwave Sintering of Ceramics
- Global Environmental Sciences
- Genome Mapping and Sequencing
- Modular High-Temperature Gas-Cooled Reactor Technology Development
- Advanced Control Test Operation
- Bioprocessing in Fossil Energy

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Technology Transfer Through Licensing
Achievements To Date

Cumulative	FY 89	Total
License Agreements	5	32
Licenses with local firms	1	8
Royalty Income ($K)	179	686
Product Sales ($M)	3.7	17.8
Invention disclosures evaluated	71	180
Patent waivers granted	21	68

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ORNL-DWG Z-12461

Goals Of The Oak Ridge National Laboratory University And Educational Programs

- Programs for university students and faculty are aimed at:
  - Encouraging more students towards graduate school through providing exciting research experiences
  - Enhancing undergraduate and graduate education through unique enrichment opportunities
  - Enticing superior students to choose energy-related careers

- Programs for precollege students and teachers are aimed at:
  - Increasing the number of students who select science and mathematics career paths
  - Developing a scientifically literate public
  - Stimulating teachers to increase both the quality of instruction and their career enthusiasm

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ORNL-DW Z-12470

ORNL Science Education Student And Faculty 1989 Participants* Appointed Through The Office Of University and Educational Programs

Academic Level	Total # of Participants
K - 12th grades (EPS Study Center)	9,000
High School Students	63
High School Teachers	22
Associate Degree	6
Undergraduates	149
Graduates	29
Postgraduates	42
Faculty	32

*Numbers or estimates based on projected offers/acceptances.

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