

Critical Connections

The 80-year partnership between UT and Oak Ridge

Lee Riedinger

**Emeritus Professor of Physics
Emeritus Director, Bredesen Center
University of Tennessee**

lrieding@utk.edu

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Book now in print

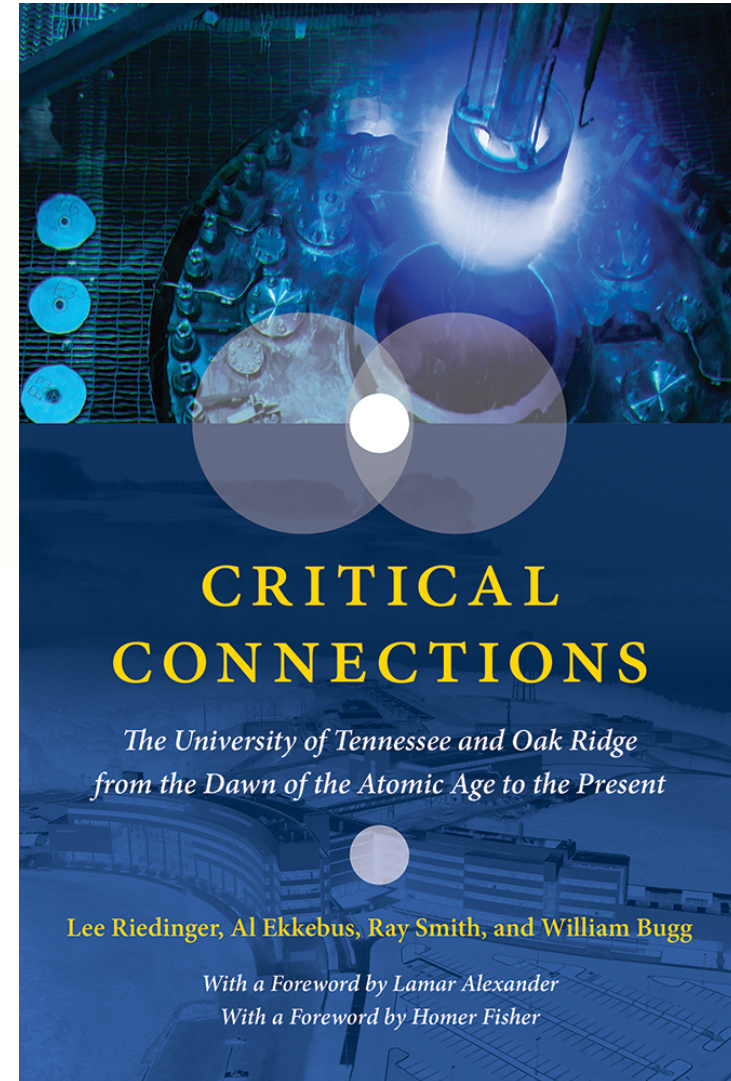
Critical Connections

The University of Tennessee and Oak Ridge
from the Dawn of the Atomic Age to the Present

**LEE RIEDINGER, AL EKKEBUS, RAY SMITH,
AND WILLIAM BUGG**

Edited by
David Brill and Mary Zuhr

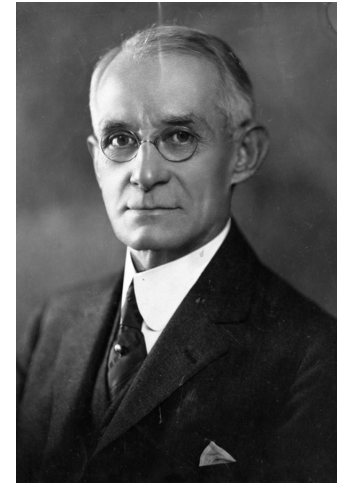
UT Press



UT and Oak Ridge in 1940

- Oak Ridge - did not exist
 - Farming communities: Scarboro, Elza, Wheat, and Robertsville - small self-sufficient farms
 - TVA's Norris Dam was completed in 1936; Watts Bar Dam completed in 1939 - finally rather abundant electricity in the Tennessee valley
- UT - not a very good university
 - Tough financial times in 1930s, poor leadership by President James Hoskins
 - State did not see a need for higher education
 - No PhD programs, little faculty research
- UT needed the Manhattan Project and Oak Ridge to advance
- Oak Ridge needed UT to fully develop

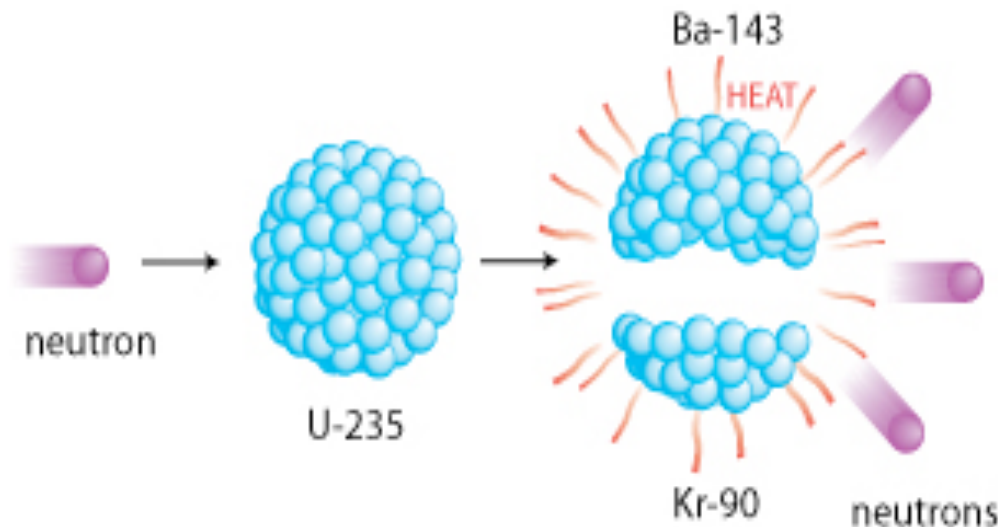
23 Critical Connections over 80 years



James Hoskins, UT
president 1934 - 46

Nuclear fission - understood by 1941

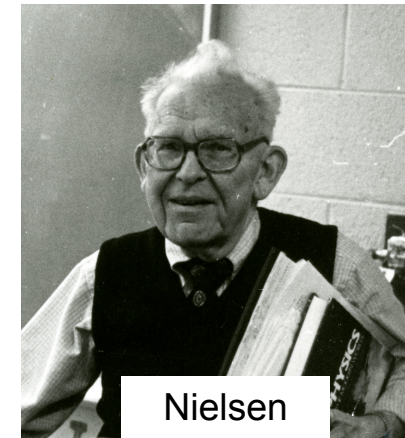
- It is ^{235}U that fissions when ^{235}U absorbs an incident neutron
- Around 200 MeV of energy is emitted - huge source of energy - nuclear energy from 1-kg of uranium = chemical energy from 2000 tonnes of coal
- December 2, 1942 - team led by Enrico Fermi initiated first artificial nuclear chain reaction in a lab at the University of Chicago
- Next step - find a way to enrich uranium in 235 to build a bomb - **Oak Ridge**
- Next step - scale up Fermi's pile to a continuously operating reactor - **Oak Ridge**
- Purpose - breed ^{239}Pu in reactor, an even better fission source than ^{235}U



Emitted neutrons can cause other uranium nuclei to fission if they are slowed down, forming a chain reaction

Physics Department in 1940

- Kenneth Hertel - department head
 - Started research on cotton fibers in 1934 when state had halved UT's budget - research to help state
 - Helped form UT Research Corp and got its first patent in '39
- Alvin Nielsen - joined faculty in 1935; UT had 2500 students
 - Later Physics Head and dean of the college
 - Physics building named after him
- Katherine (Kay) Way - joined faculty in 1939
 - BA degree from Columbia University in 1932
 - PhD in nuclear physics from North Carolina in 1938
- William Pollard - joined faculty in 1936
 - BA in math from UT in 1932
 - PhD in physics from Rice University in 1935
 - Ordained as priest in Episcopal Church in 1954



During Manhattan Project, Pollard worked at Columbia on gaseous diffusion and Way worked in Chicago on reactor physics

Critical Connection #1 in 1945

Oak Ridge requests grad courses by UT

- WWII over in September - what is future of Oak Ridge?
- Martin Whitaker (first director of Clinton Labs) was concerned about future
 - Hoped to keep Oak Ridge facilities going even though war was over and mission had been fulfilled
 - Wanted to keep research workforce (around 600) in place but needed a nearby educational partnership to help those pulled out of grad school finish their advanced degrees locally
- September 1945 - dinner meeting called by Fred Smith, dean of UT Graduate School
 - Attending: Martin Whitaker (director of Clinton Labs) and Warren Johnson (director of Chemistry Division)
 - Oak Ridge needs on-site grad courses for researchers
 - Two physics grad courses started at Oak Ridge on-site in October



Martin Whitaker



Fred Smith

Beginning of UT- Oak Ridge partnership

New idea of university involvement in Oak Ridge - 1945

- September - Robert Boarts (head of Chemical Engineering) - hosted a party to welcome Kay Way back for a visit to UT
- November 8 - dinner meeting at Andrew Johnson Hotel - Smith, Hertel, Pollard, six Clinton Lab staff
- December 5 - Pollard organized a *Conference on Research Opportunities in the Southeastern U.S.* in Knoxville (Andrew Johnson Hotel) - how to leverage Oak Ridge facilities for benefit of universities - 9 universities attended, plus UT
- Bill Pollard was appointed as chair of committee to take next steps on a university consortium



Critical Connection #2 in 1946

Formation of ORINS

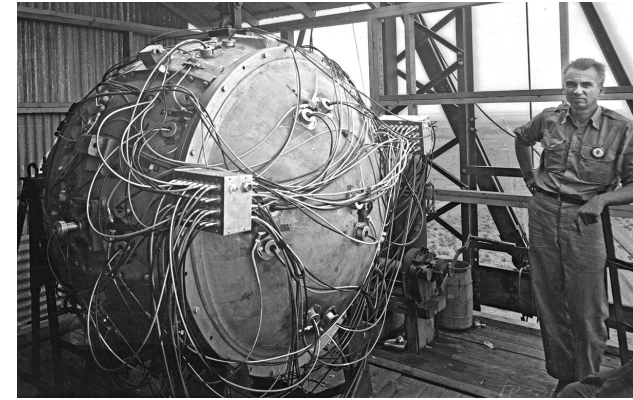
- Result was a plan for *Oak Ridge Institute of Nuclear Studies* (ORINS) and an executive committee with Pollard as chair
- ORINS formed in October 1946 with 14 member universities including UT and Vanderbilt; Pollard - director until 1974; became Oak Ridge Associated Universities (ORAU) in 1966
- Spring quarter 1946 - UT offered graduate courses in chemistry, chemical engineering, math, and physics for Oak Ridge contractor employees and Army personnel
 - UT's OR Resident Graduate Program - first official UT-Oak Ridge partnership
 - Graduate courses were held after work at Oak Ridge High School
- ORINS helped make case for continuation of Clinton Laboratories when many feared the government would close the lab after WWII

Beginning of official UT role in graduate education in Oak Ridge

UT-AEC Agricultural Research Laboratory

Critical Connection #3

- July 16, 1945 - *Trinity* test of first atomic bomb - in desert in New Mexico
- 50 cows affected by fallout were sent to Oak Ridge
- 1948 - cows put on 5000 acres in Oak Ridge and studied in new *UT-AEC Agricultural Research Lab*
- No long-term effects of fallout exposure on cows:
 - Cows arrived with gray hair but normal hair returned
 - 33 calves produced were normal - no evidence of adverse effects on fertility
 - Milk was not radioactive
- Field of nuclear medicine developed in part due to research on animals at the UT-AEC Agricultural Research Laboratory
 - Radioactive ^{72}Ga (14 hr half-life) produced in Graphite Reactor and brought to Ag Research Lab and injected into a pig
 - Experiment proved that gallium concentrates in bone and can be used to kill a tumor - beginning of nuclear medicine



Name changed to Comparative Animal Research Laboratory (CARL) in 1970s

Huge impact of Oak Ridge on UT

Already in early 1950s

- Nuclear-associated courses in Chemistry, Engineering, Physics, Economics, Sociology, Political Science
- Science and engineering courses offered in Oak Ridge
- **First PhD programs established - Chemistry, Physics, Botany, Chemical Engineering** - largely due to interest from Oak Ridge
- Increased number of graduate students
- Access to radioisotopes for research - faculty research grants based on proximity to Oak Ridge
- Many Oak Ridgers got their PhDs at UT in 1950s - e.g., Sam Hurst, Rufus Ritchie, Ed Von Halle, Sheldon Datz
- 1951 - 29 UT faculty are Oak Ridge consultants -
Critical Connection #4 - beginning of shared researchers between UT and Oak Ridge - would evolve into *joint faculty* 34 years later



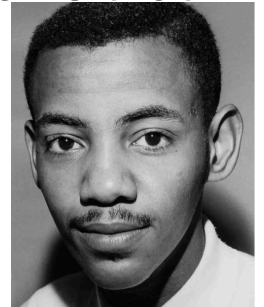
Sheldon Datz

Big impact on Oak Ridge - graduate degrees for important researchers

Desegregation in Oak Ridge and at UT

Critical Connection #5

- 1952 - UT admitted first few Black grad/law students
- May 17, 1954 - landmark Brown v. Board of Education decision by U.S. Supreme Court
- September 3, 1954 - President Eisenhower barred racial discrimination by private contractors receiving government funds
- December 31, 1954 - notice to UT President Brehm - executive order would apply to UT when it renewed its contracts with AEC
- October 1956 - Tennessee Supreme Court ruled that all state laws that codified segregation were invalid
- But, UT would not admit Black undergrads
- 1960, Knoxville native Theotis Robinson applied to UT as an undergrad - denied
 - Theotis and parents met with President Andy Holt - threatened law suit
 - November 18, 1960 - UT Board of Trustees ruled against racial discrimination
 - January 3, 1961 - Robinson and two other Blacks registered as undergrads



Oak Ridge desegregation

- AEC announced in January 1955 that Oak Ridge public schools would desegregate in September 1955 - 40 Black students entered high school
- Pressure in Kennedy administration to end discrimination in federal cities
- 1963 - Bob McNees - ORNL chemist and mayor of Oak Ridge - formed Human Relations Committee chaired by James Spicer, pastor of Chapel on the Hill - they learned that Davis Brothers Cafeteria was a big symbol of discrimination
- Spicer and McNees flew to Atlanta to visit Davis Brothers - no change in policy resulted
- Flight home - Spicer sat next to Emerson Glazer, son of man who built Oak Ridge shopping center
- Next day, Gene Joyce called in Spicer to offer a deal to end segregation at Davis Brothers Cafeteria
- This worked and Davis Brothers desegregated all of their restaurants in South

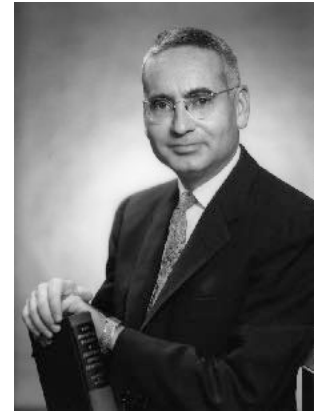


Alvin Weinberg - ORNL director 1955 - 1972

Big impact on building the partnership

Critical Connections 6 and 8

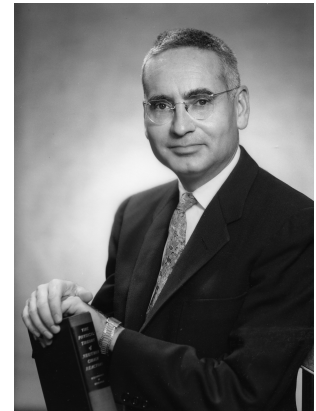
- Leader of ORNL building 9 different reactors in 50s
- UT formed *Nuclear Engineering Department* in 1957
- Formed UT-Oak Ridge Graduate School of Biomedical Science
 - Started in 1967 after conversation with National Institutes of Health - utilize ORNL Biology Division for graduate degrees - MS and PhD
 - Faculty were researchers in Biology Division with part-time UT status
 - Students took courses, lived in Oak Ridge, did research in Biology Division
 - School died after 30 years



Forerunner of the Bredesen Center started in 2010

Weinberg's vision for education - 1962

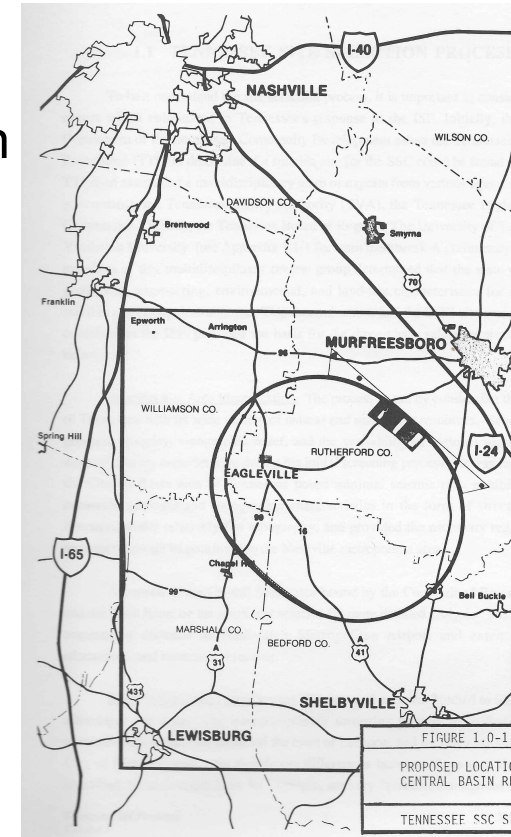
- National labs need to contribute to education of scientists and engineers; but how?
- Maybe establish *federal universities* - some national laboratories would be expanded to include academic programs for graduate students, issuing degrees
 - Would not be popular among universities
- Establish “joint institutes” with neighboring universities - students get their degrees from the university and national lab researchers would serve as faculty of that university as they guided the students in their dissertation research
 - An idea ahead of its time; did not happen fully until the Bredesen Center was started in 2010 between UT and ORNL



A. M. Weinberg, “Federal Laboratories and Science Education,” *Science*, 136(3510), April 6, 1962, p.27ff

Missed opportunities in high-energy physics

- Collider for high-energy physics - 1965 - \$348 million
 - AEC planned to build a 200 GeV accelerator; largest at that time was a 33 GeV machine at Brookhaven National Lab
 - States submitted 200 potential sites - list narrowed to 85 including a site in Memphis and in Oak Ridge near K-25
 - May 1966 - TN sites removed from list; Nashville *Tennessean* article blamed it on TN's rank as #48 in spending on education
 - Competition won by Illinois, Fermilab located near Chicago
- SSC - superconducting supercollider - 1987 - \$4.4 billion
 - TN proposal sent to DOE on 8/21/87 by Gov McWherter
 - Site south of Nashville - 5 miles from I-24
 - November 1988 - DOE chose site south of Dallas; Time magazine (11/28/88) said that TN finished second
 - UT and ORNL and other partners then started competing in 1990 to build a huge detector for the SSC - LSTAR
 - Congress killed the SSC on 10/30/93 after \$2B had been spent and total cost had gone up to \$12B estimated



Jack Gibbons - ORNL to UT to Washington

- 1954 - PhD from Duke, joined ORNL Physics Division - studied role of neutron capture in nucleosynthesis of heavy elements in stars
- 1969 - started ORNL's new environmental program
 - Initiated research on energy efficiency and explored environmental impacts of energy production and use
- 1973 - first director of U.S. Federal Office of Energy Conservation
- 1975 - returned to Tennessee to create and lead UT's Energy, Environment, and Resources Center
- 1979 - back to Washington to head Office of Technology Assessment - nonpartisan agency to provide Congress with analysis of technical challenges facing society
- 1993 - 1998 - served as President Bill Clinton's science advisor



Critical Connection #11 -
first energy center at UT



Change of Oak Ridge contractor in 1984

- May 3, 1982 - Union Carbide announced end of management role of 3 facilities; UT formed task force to consider a bid
- October 1982 - Paul Huray, Ivan Sellin, and Riedinger (3 Physics faculty) came up with idea of *Distinguished Scientist* program - top science and engineering faculty hired 50:50 with ORNL at a 'crazy' salary of \$100K plus research support money
- Jack Reese sent idea to Governor Alexander who went to meet Majority Leader Baker and DOE Secretary Hodel, who agreed to support Distinguished Scientist program
- January 19, 1983 - DOE announced keeping contracts together - K-25, Y-12, ORNL, Paducah - UT dropped from competition
- February 7, 1983 - Chancellor Reese and ORNL Director Postma agreed to start **Distinguished Scientist** program independent of new contractor decision (and without lawyers review!) - **Critical Connection #12**
- April 1984 - Martin Marietta took over as manager of five plants - three in Oak Ridge plus gaseous diffusion plants in Paducah and Portsmouth



Jack Reese
UTK chancellor
1973 - 1989



Herman Postma
ORNL director
1974 - 1988

UT not ready to compete for Oak Ridge management contract but would be ready 15 years later

Challenge to hire first Distinguished Scientists

- June 1983 - first UT/ORNL meeting to start to consider candidates for new Distinguished Scientist program
- October 1983 - I went to DC for a year to work as Baker's science advisor
- February 1984 - first two joint hires proposed - George Bertsch (nuclear physicist at Michigan State) and Jerry Mahan (materials physicist at Indiana University)
- Bertsch said he would accept only if his hiring would make the NY Times
- How to ensure that? I asked Senator Baker to host the ceremony
- June 11, 1984 - first two UT/ORNL Distinguished Scientists hired in ceremony in Mansfield Room in U.S. Capitol, hosted by Senator Baker
- The hires made national press and Bertsch was happy
- 20 such hires over following 15 years

UT did not win management contract but did gain a new foundational partnership program



1980s - Lamar Alexander helped build the partnership

- Governor 1979 - 87: first of five consecutive governors to directly invest in UT-Oak Ridge partnership
 - UT and ORNL committed to new *Distinguished Scientist* program to jointly hire top scientists and engineers in areas of joint strength
 - New state program - Centers of Excellence - UT wins first award for UT-ORNL Science Alliance - **Critical Connection #13**
- Fall 1984 - Science Alliance state funds helped hiring of Distinguished Scientists and operation of first *joint institute* -- **Critical Connection #14**
 - Joint institute building constructed with \$350K from state of Tennessee appropriation
 - First state building at a federal DOE lab
 - Served nuclear physics programs of UT and Vanderbilt groups for 35 years



Founders of first UT-ORNL *joint institute*: Lee Riedinger (UT), Russell Robinson (ORNL), and Joe Hamilton (Vanderbilt), October 1984

Visit of President Bush to UT - February 1990

- Bush's State of Union address on 1/31, then visits to North Carolina State and UT on 2/2 to promote his plan to double budget for NSF
- Science Alliance was one of two highlights on Bush visit to UT
- I was the Science Alliance director and had 20 minutes sitting next to the president to talk about UT and ORNL
- A really cool experience! Set up by Lamar Alexander



Lee Riedinger, President Bush, Governor McWherter, Lamar Alexander (UT president), and three distinguished scientists: Jack Weitsman, Gerald Mahan, Bernhard Wunderlich

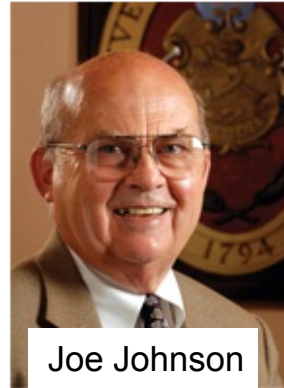


Science Alliance briefing: David Joy (Distinguished Scientist), John Quinn (UT Knoxville chancellor), President Bush, Lee Riedinger (Science Alliance director) - February 2, 1990.

1998 - UT decided to compete for ORNL contract

- May 1998 - rumor that DOE would not renew Lockheed Martin management contract for ORNL
- President Joe Johnson formed a task force chaired by Vice President Homer Fisher and Lee Riedinger
- October and November - interviewed 15 possible bid partners
- Late November - visit by Bill Madia, director of Pacific Northwest National Lab - *UT-Battelle LLC* was born - **Critical Connection #16**
- July 22, 1999 - Governor Sundquist committed \$12 million of construction funds for new joint institutes should UT-Battelle win; the state turned down similar request from Lockheed Martin
- August 16 - oral presentation of proposals to DOE Source Evaluation Board
- October 20, 1999 - phone call to say that UT-Battelle won
- April 1, 2000 - UT-Battelle starts managing ORNL; 3 UT people on initial leadership team: Lee Riedinger, Billy Stair, Frank Harris

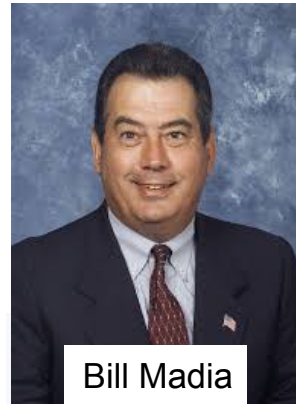
Huge victory for UT, 60 years after not even having any PhD degrees and very little research



Joe Johnson



Homer Fisher



Bill Madia

Rapid turnover of UT presidents in 2000s - all resigned early



Wade Gilley
1999 - 2001



Joe Johnson
Interim



John Shumaker
2002 - 2003



Eli Fly
Interim



John Petersen
2004 - 2009

Progress continued at UT due to work of many people below the presidents, e.g.,
Chancellor Loren Crabtree (2003 - 2008)



Wade Gilley downfall

- November 2000 - Madia told Riedinger to get Vanderbilt into Core University fold
- Riedinger talked to leaders of current core universities and of UT, and response was 'no problem'
- May 23, 2001 - Riedinger proposed this addition of Vanderbilt to UT-Battelle Board of Governors
- UT President Wade Gilley was chair of board that year, and he reacted very strongly against proposal, berating Riedinger in process
- A very disturbing episode, but Riedinger understood the situation two days later - story in News Sentinel, leading to a string of articles:
 - David Keim, "UT Official under Scrutiny," Knoxville News Sentinel, May 25, 2001
 - David Keim, "UT administrator Reed resigns - She cites concern," Knoxville News Sentinel, June 14, 2001
 - David Keim, "Reed claims love for Gilley," Knoxville News Sentinel, June 14, 2001
 - David Keim, "Gilley e-mail reveals sexual liaison with Reed," Knoxville News Sentinel, July 20, 2001

Wade Gilley resigned as
UT president June 1, 2001

In contrast to UT, a seamless transition in ORNL directors in 2000s



Bill Madia
2000 - 2003



Jeff Wadsworth
2003 - 2007



Thom Mason
2007 - 2017

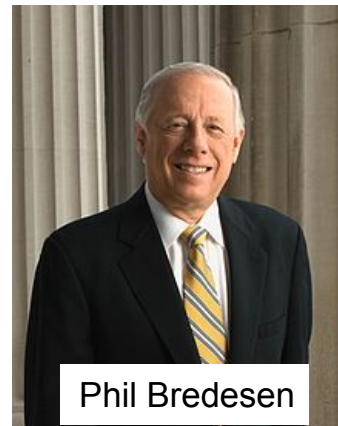
Excellent continuity of ORNL directions and missions

Governor Phil Bredesen (2003 - 2011)

Chancellor Jimmy Cheek (2009 - 2017)

ORNL director Thom Mason (2007 - 2017)

- Bredesen provided:
 - 2005 - new money to hire *Governor's Chairs* between UT and ORNL - **Critical Connection #18**
 - 2006 - new money for the Tennessee Biofuels Initiative
- 2010 - Bredesen had idea for a joint PhD related to energy
 - Cheek and Mason proposed an *interdisciplinary center* at UT and a joint PhD in *energy science and engineering* between UT and ORNL; \$6M provided; I set this up and directed Bredesen Center until retirement at end of 2019
 - **Critical Connection #19**
- 2014 - Bredesen helped convince Governor Haslam to support new UT/ORNL PhD in *data science and engineering*



Huge contributors to the partnership

UT-ORNL Bredeesen Center

- The result of 80 years of progress in joint education and research - a fulfillment of Alvin Weinberg's ideas in 1962
- Formed in 2010, led by Lee Riedinger until 2019
- Excellent grad students, most working on dissertation research at ORNL and taking courses in departments at UT; faculty from UT and ORNL
- Grad students have started 9 companies
- 12 PhD grads work in policy roles in the DC area

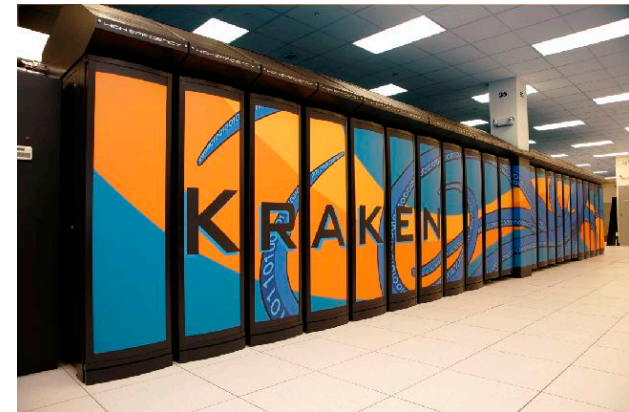
Participants in October 7, 2011 meeting:
front row: students Stephen Wood, Kemper Talley, Callie Goetz, and Kyle Sander;
back row Riedinger, Jim Roberto, Phil Bredeesen, Jimmy Cheek, and Jim Murphy



Rise of supercomputing at ORNL and UT

Critical Connection #20

- Jaguar - 1 petaflop (a million billion operations per second) computer funded by DOE to ORNL in 2007
- Kraken - 1 petaflop computer funded by NSF to UT in 2008
- Both sat side-by-side in new building at ORNL, sharing power and cooling capabilities
- Thomas Zacharia took the lead on both; became a tenured joint faculty member at UT to take the lead on NSF proposal
- 2018 - DOE funding to ORNL for *Summit*, 8 times more powerful than previous top-ranked *Titan*, at 200 petaflops
- 2021 - *Frontier* at 1.5 exaflops - most powerful supercomputer



Thomas Zacharia



Some of top science directions

- Additive manufacturing - **Critical Connection #22**
 - Manufacturing Demonstration Facility (MDF) opened in 2012 adjacent to NTRC on Hardin Valley Rd
 - MDF researchers used 3D printing to make a Shelby Cobra car, driven by President Obama on a visit in January of 2015
 - A strength of both institutions, in part by the hiring of Governor's Chairs - Suresh Babu in 2013 and Uday Vaidya in 2015
- Heaviest elements in nature
 - Element 117 (*Tennesine*) discovered in a long experiment in Dubna with target - ^{249}Bk - made in HFIR at ORNL
 - ORNL, UT, Vanderbilt physicists involved
 - Grew out of partnership in nuclear physics: 1970 - formation of University Isotope Separator at Oak Ridge (UNISOR) by 12 universities led by UT and Vanderbilt; first user facility at ORNL - **Critical Connection #10**



Suresh Babu

Renewed partnership with Y-12 National Security Complex

- 2011: MOU to guide future joint programs - Chancellor Jimmy Cheek and Y-12 General Manager Darrel Kohlhorst
 - Monthly meetings of joint working group
 - Nine UT colleges became involved in partnerships with Y-12
 - Joint Assignment Agreement signed to allow formal exchange of personnel
 - Engineering Management Graduate Program initiated and taught in Oak Ridge
 - Graduate research assistantships for 30 UT students working at Y-12
 - Faculty collaborations started in 8 areas, including nuclear forensics, testing of radioactive shipping containers, archiving Manhattan Project documents, strengthening nuclear-science education in K-12 curricula, launching Y-12's Total Health Risk Intervention and Education initiative
- 2022: \$9.5M agreement between UT and Consolidated Nuclear Security - Y-12 manager Gene Sievers and Deborah Crawford, UT vice chancellor for research
 - UT support Y-12 in driving implementation of new technologies; Y-12 serves as incubator for innovations applied to key national security mission areas

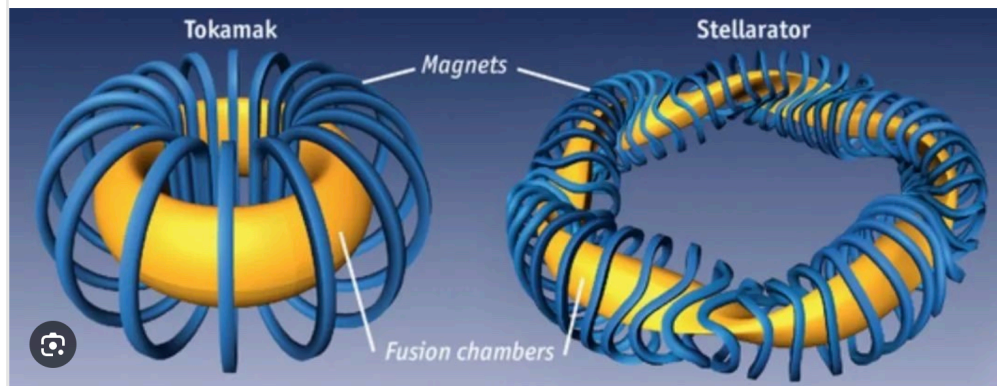
Future of the partnership

- Lessons learned from 80 years of the partnership
 - Support needed from governors, presidents, chancellors, lab directors
 - Key people must work for partnership sacrificing their own accomplishments
 - Sharing of people, resources, and facilities is crucial
 - Maintain *interdisciplinary* emphases in research and education
 - Grow next generation of scientists and engineers
- University/national lab groups have come to study this partnership
- Important areas of joint research in future:
 - Supercomputing applied to many areas
 - Quantum information science
 - Electric vehicles - Volkswagen has a research lab on UT's Cherokee Farm
 - Neutron science - second target station to be built at SNS
 - **Nuclear reactors - next generation - even molten salt reactors**
 - **Fusion - maybe fusion power reactors by mid-century**
 - Direct capture of CO₂ from atmosphere
 - Isotope production and separation - *back to the future*

Nuclear energy on the rise

Fission and even fusion

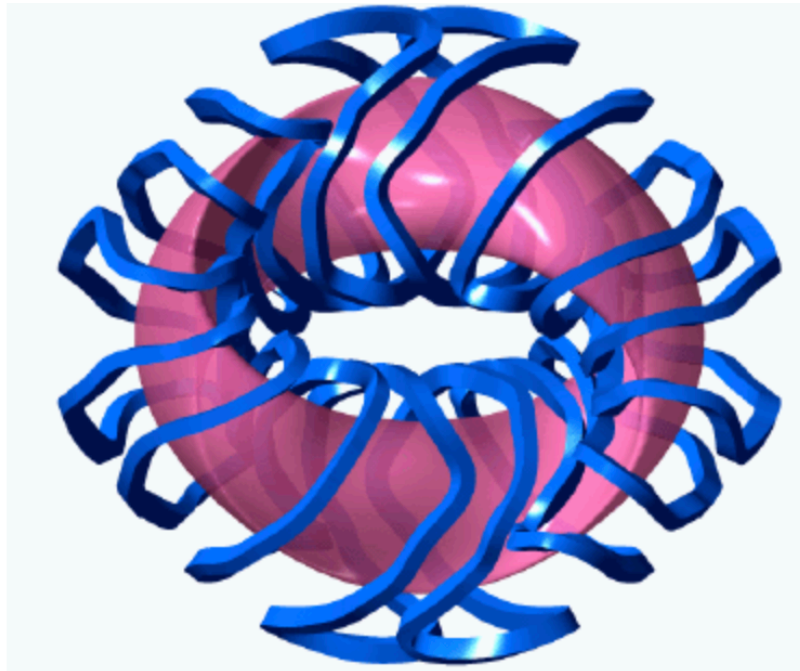
- Fission
 - TVA - Small Modular Reactor on Clinch River site
 - Kairos Power - build Hermes, test pebble-bed reactor with molten salt coolant
 - X-Energy - make TRISO-X fuel pellets
 - Ultra Safe Nuclear - micro modular reactors, pebble fuel, He cooled, inherently safe
 - Centrus Energy Corporation - build centrifuges for U enrichment - plant at Piketon, OH with 16 units
 - LIS Technologies - coming - laser separation of U - from Davis CA
- Fusion
 - ITER -Tokamak in France
 - Type One Energy - build a stellarator in Bull Run Steam plant



ORNL proposed a stellarator

QPS - quasipoloidal stellarator

- Proposed in early 2000s
- Not funded - national focus on funds for ITER



QPS proposal

ORNL working with Type One Energy on their plans for a stellarator in the Bull Run Steam Plant

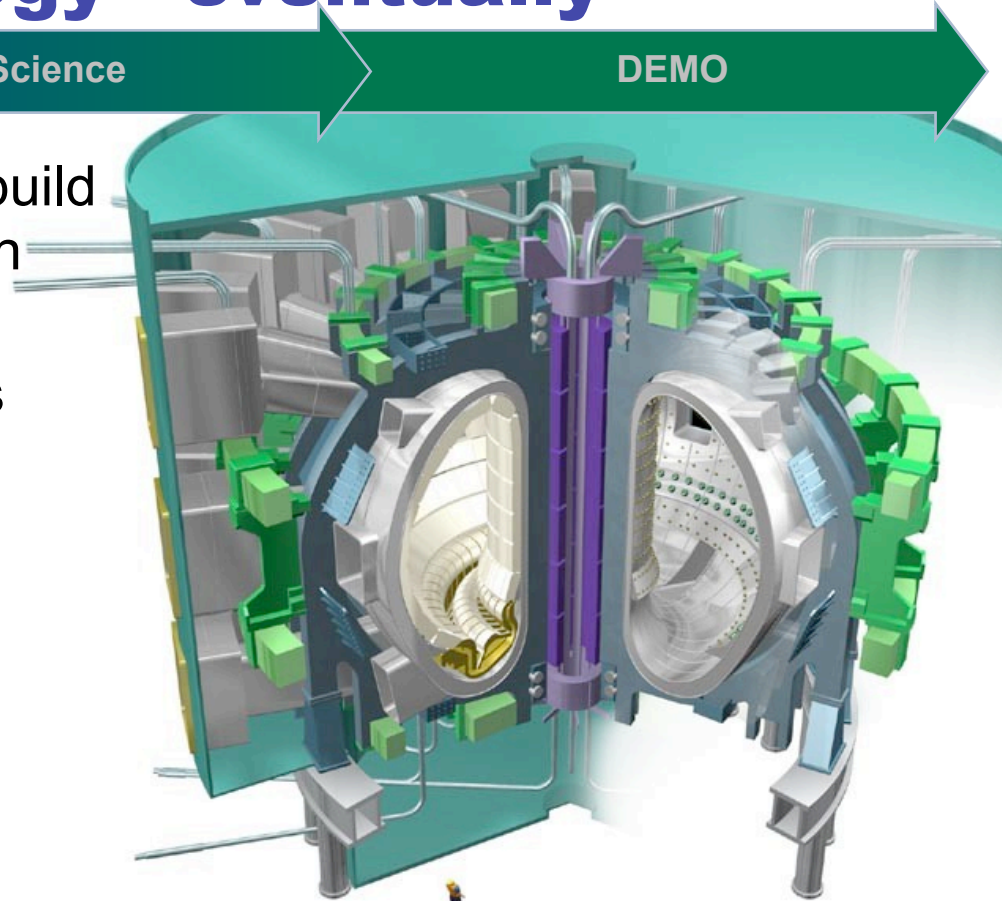
Fusion: on track to play a role in the world energy strategy - eventually

ITER

Science

DEMO

- Many countries are teaming to build ITER in France - next generation Tokamak - 500 MW
- ORNL manages U.S. role in this \$23B project (cost going up)
- Several steps are needed after this to take us to a fusion power reactor



EU



Russia



Japan



USA



China



South
Korea



India

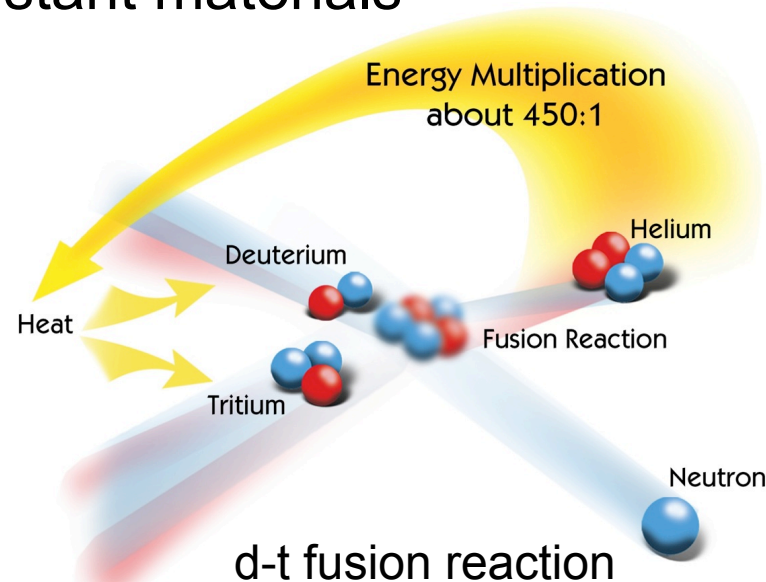
Huge fusion problem - integrity of 'first wall'

- Burning plasma generates 14 MeV neutrons - intense neutron flux on walls of reactor
- A fission reactor (lower energy neutrons) produces 1.5 displacements per atom in surrounding material (fuel cladding)
- ITER will produce up to 3 dpa
- A fusion reactor - maybe 150 dpa
- Must study materials science in this environment - develop high-performance, radiation-resistant materials



Steve Zinkle

UT-ORNL Governor's Chair

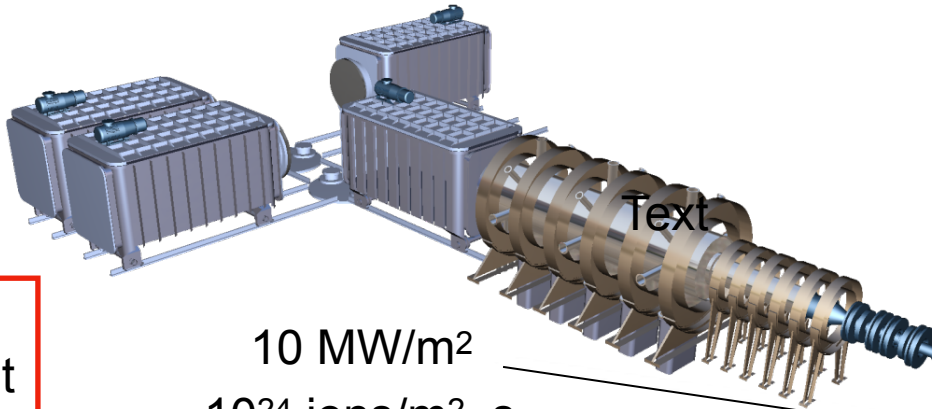


d-t fusion reaction

Material Plasma Exposure Experiment at ORNL

Provide a platform to study science of materials and performance of components subjected to conditions posed by fusion plasmas: simultaneous high heat and charged particle fluxes

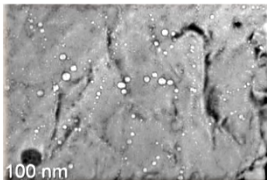
Material Plasma Exposure Experiment (MPEX)



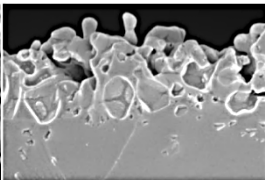
Study materials at 10 - 50 dpa

10 MW/m²
10²⁴ ions/m² · s

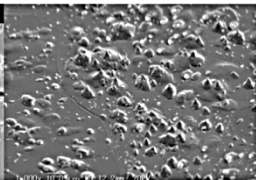
Plasma-tungsten surface interactions showing all potential defect formations and eventual bulk failures



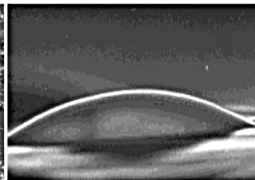
Void formation



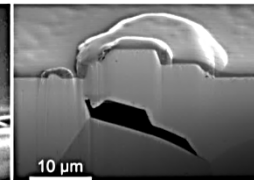
Bubbles in W by He



Blisters within grains



Large Blisters due to voids at grain boundary



ITER transients

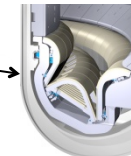


2000

85

<10

Power load [MW/m²]



ITER Divertor

Oak Ridge Innovation Institute at UT

Started in 2020 - Critical Connection #23

- New funds for partnership from DOE and from state of Tennessee
- Investment in new areas of joint research - February 2024 awards:
 - Bioeconomy systems - develop low-carbon agriculture and manufacturing
 - Radiopharmaceutical therapies - new therapy and diagnostic imaging drugs
- Emphasis on technology development
- A future based on evolution of the partnership over 80 years
- Leaders in building partnership over 80 years are gone or retired
- A strong team of new leaders at UT and ORNL is in place
- **The future is bright**



Stephen Streiffer
ORNL director



David Sholl
ORII director



Randy Boyd
UT president



Dondi Plowman
UTK chancellor

UT + ORNL = INNOVATION