Socioeconomic Impact Assessment in a Complex Economic Environment: The Case of Hanford

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ABSTRACT

This presentation was to have been given in coordination with several others which shared, as a common focus, the analysis of potential socioeconomic impacts of a proposed high-level nuclear waste repository at the Hanford Site, Washington. In December of 1987, Congress removed the Hanford Site from consideration as a repository location and, effectively and immediately, terminated the socioeconomic study. For this reason, the other papers were not funded, and will not be presented here.

The immediate drawback to all of this is that this paper cannot be presented in the context created by the other papers as intended. This paper presents one important aspect of the difficulties associated with long-term socioeconomic impact projections at the Hanford Site, and has a narrower focus than otherwise would have been the case. The focus will be on establishing baseline conditions against which project impacts are to be assessed and in this paper consider only two areas: employment and population.

STUDY PURPOSE AND OBJECTIVES

In the broadest sense, the purpose and objectives of the study were: "...to identify and quantify, where possible, the full range of socioeconomic impacts resulting from repository-related activities at Hanford."

HISTORICAL BACKGROUND

The Hanford Nuclear Reservation has been associated with nuclear activities of the federal government since 1943 when the area was set aside as a reservation for the production of plutonium for the world's first atomic weapons. It was selected as a nuclear reservation because of the area's favorable combination of small resident population, and easy access to rail transportation, Columbia River water, and hydropower generated by the Grand Coulee Dam.

The nation's search for a suitable repository for high level nuclear waste (HLNW) in deep geologic formations in now more than thirty years old (Carter 1987; 54). Over the course of the years, policy directions have shifted several times. For over a decade, until the most recent shift in December of 1987, the Hanford Nuclear Site/Reservation in southwestern Washington State had been under active consideration as a HLNW repository site. Investigation of the basalt formations at the site for a HLNW repository first began in 1976, and Hanford continued to be investigated during the time when national policy on the nuclear waste issue took shape as the Nuclear Waste Policy Act of 1982. Under the provisions of the Act, Hanford was selected in February 1983 as one of nine sites potentially acceptable as the nation's first high-level nuclear waste repository. After additional study, in May 1986 Hanford was selected as one of three candidate sites for extensive characterization (the others were Yucca Mountain, Nevada, and Deaf Smith County, Texas). The multilayer characterization process was intended to narrow the field of three down to one site based on scientific grounds. The process was abruptly terminated when Congress decided, in December 1987, to proceed to characterize only the Yucca Mountain Site for the nation's first permanent nuclear waste repository.

OBJECTIVES OF THIS PAPER

In this paper I am only concerned with the problems of assessing the potential future standard social and economic impacts of a proposed high-level waste repository at Hanford Site, Washington. This is not to deny the possibly even greater importance of the special impacts likely to occur as a result of the decision to construct, the construction, and operation of such a repository. Before I discuss the problematic standard impacts to be dealt with at the proposed Hanford Site, a brief discussion of the differences between these two kinds of impacts is in order.

Standard Impacts

Standard impacts are those that would be associated with any construction project of comparable scale. Direct standard impacts are from the work being performed on site investigations and the assessment (e.g., hiring new workers and acquiring equipment); indirect standard impacts are from the presence of the new workers and their families in the community, and from the process of planning and decision making on the project. The list of potential indirect standard impacts includes demands on community services (e.g., housing, sewer, and water system capacity, schools); increased demand on some sectors of the local economy (e.g., auto repair operations, restaurants increased employment); and an array of individual and community responses to psychological and social disruption (e.g., increase in vandalism, increase in mental health counseling loads, increase

in personal stress factors as a result of project factors such as rapid growth).

Social Impacts

Special impacts are those that result from the attributes of the project that are due to its nuclear dimension. These impacts result from extraordinary length of time over which impacts could occur (10,000+ years) and the radiological nature of the repository. Special impacts can be both physical (e.g. radiological protection measures in construction, operations, and monitoring) and perceptual (i.e., what the public perceives might, or could, happen because nuclear materials are transported, handled and stored). Obviously, there is considerable overlap between standard and special impacts. The focus of this paper, however, will be on standard impact prediction only.

In order to remain within the time and space constraints of this paper, the geographical area covered in this analysis includes only the primary impact area for the repository, and does not consider multi-regional or state level analysis. The primary impact area includes the Hanford Reservation itself, the Tri-Cities of Richland, Kennewick, and Pasco, and the immediately adjacent areas, including Benton and Franklin Counties. (Obviously there are other nearby areas that are important for analysis, but they will not be treated here.)

THE BASE CASE AND BASE LINE APPROACH

I will begin by providing a capsule discussion of the social and economic context of the Tri-Cities environment. This is the "base ease": the current environment within which the proposed repository development would take place. It is, due to time and space constraints, covered very briefly in this presentation.

The main part of the talk will center on the problem of establishing "baseline" conditions against which project impacts are to be assessed. Whereas "base case" conditions are defined as conditions existing at one point in time, in this instance at the beginning of the project, "baseline" conditions are projected future conditions or trends over a specified range of years based on a given set (or sets) of assumptions. (It would perhaps be more clear to term "base case" conditions "base point" conditions, but this is not the current standard nomenclature. The significant contrast between "base point" and "base line" however, is more readily apparent than it is with the terms commonly used now.)

DIFFICULTIES OF A BASELINE APPROACH

An analytic approach that relies primarily on a ceteris parabus (all things being equal) argument for the analysis of technological, social, and cultural environmental effects has a fundamentally erroneous assumption. It is a certainty that the technological changes occurring over the next fifty years will continue to accelerate. Future developments will have a significant effect on the attitudes, perceptions and beliefs of local residents.

Our experience has shown that the commonly-employed modeling approach of anticipating the effects of a development project by making two sets of projections of sociocultural changes in the impact area, one assuming development and the other assuming a continuation of present trends without the development project occurring, is inadequate to the task. While suitable for relatively short-term (ten-to twenty-year) projections, even very small variances in the anticipated economic or social trajectory will result in astronomical variance in the long-term. As a result, pre-development projections are often seriously misleading. In addition, post-development retrospective analyses of change which attempt to assign causality to particular development stimuli are exceedingly difficult, if not impossible, to conduct.

When assessing special effects, as detailed elsewhere, assessment of the interactive and cumulative effects of location the repository at the Hanford Site is essential. Any nuclear-related development project will add to the complexity of interactive social effects in an area already sensitized to environmental issues. Understanding the cumulative effects of proximity to these potential sources of environmental risk is essential to understanding the incremental increase in stress caused by the addition of the proposed repository site.

In summary then, the process of making assessments over long timer periods is made more complex, if not impossible, by inevitable and largely unanticipatable changes in the sociocultural environment brought about by future social trends, changes resulting from unanticipated technological development, and changes in assessment methodologies. These realities underscore the fact that accurate data collection is essential, and that a monitoring and mitigation system must provide a "real time" response capability.

RECENT DEVELOPMENTS

Activities at Hanford have gone through many changes over the past decade, and perceptions of Hanford have undergone change over the same period. Due to a series of events documented in work already completed, the positive image of the reservation as a great contributor to the economy, a trusted employer, and well managed facility, had eroded considerably as a result of an almost constant stream of revelations of contamination, of leaking storage containers on the reservation, government and media attention to the defense wastes stored at Hanford, and from unfavorable and largely inaccurate comparisons between the Chernobyl reactor and Hanford's N Reactor.

Over the years, there were periods of economic growth and decline in the area based upon activities at Hanford. In the past decade, activities at the site have been at their highest and lowest points. After a relatively slow period, the late 1970's were years of strong growth associated with the beginning of WPPSS construction on three commercial power reactors. This period of growth in employment, population, and economy ended in 1981-1982 with the WPPSS bond default.

Determining an appropriate baseline for non-repository operations at the Hanford Site in particular, or in the Tri-Cities area in general, is problematic because it is such a dynamic context. Circumstances which radically alter the socioeconomic environment take place seemingly overnight. An example of this is the recent (September 16, 1987) decision by the U.S. Senate to put "N Reactor" operations on indefinite hold. Not only does this potentially mean the direct loss of a great number of jobs, the loss of these jobs means more to the economy than the loss of many other jobs. It is definitely the not the case that "jobs are jobs." The impact of the elimination of over 6,000 "permanent" N Reactor jobs at Hanford would be far greater than the loss of 10,000 construction jobs associated with the demise of WPPSS 1 & 4 in 1981 since, unlike the construction jobs, each of the N Reactor jobs imply between two and three permanent residents and more than 1.5 indirect jobs.

In a Tri-Cities economy that provides just over 50,000 total jobs, many of which are in the lower paying service sector, this event would significantly change the economic context of potential repository development, all other things being equal. It is important to realize that this is merely one "down side" scenario and given the interrelationship of the various Hanford Site facilities, there are many others possible. There are, however, just as many development or "up side" scenarios. For example: (1) the potential conversion of the nearly completed mothballed WNP-1 facility to tritium production which would result in significant employment activity in the community: (2) the cleanup of existing Defense Waste sites (now estimated to cost in the neighborhood of $11 billion); (3) the constantly shifting funding environment for Strategic Defense Initiative ("Star Wars") and nuclear research and development activities: and (4) the emerging popularity of the competing idea of an High Level Nuclear Waste Monitored Retrievable Storage (MRS) facility at the Hanford Site. Thus, even from the perspective of short-term standard socioeconomic impacts, the range of "background" social and economic conditions, within which potential repository activities would occur, is extremely broad. How we plan to deal with this complexity is the subject of my presentation.

BASE CASE DESCRIPTION

To describe our case, we used readily available economic and demographic data to describe the economic conditions in the Tri-Cities area between 1976 and 1986. Where possible, to facilitate the analysis and to provide a more comprehensive context, we generally extend the data back to 1970. The major point here is that in describing context and what the impacts of a development will likely mean, there is no one "point in time." How impacts are felt is a function of the trends at the time of development, and must be analyzed against this background.

Specifically, we examine the following characteristics:

- Employment
- Income
- Population
- Housing
- Business activity
- Public services

BASELINE CONTEXT

Obviously, the nature of the economic development impacts depends not just on the economic characteristics of the activities in question, but also on the economic context in which the activities occurred. Increases in employment occurring, for example, in a slack labour market generally increase the economic welfare of members of the work force, but increases occurring in a tight labour market could increase the welfare of some workers (i.e., those who receive higher wages for performing essentially the same work) but decrease the welfare of others (e.g., other employers who now must pay more to hire workers).

I will consider briefly a couple of these areas: employment and population.

EMPLOYMENT

Total employment in the Tri-Cities area experienced exceptional growth between 1973 and 1981 and then an abrupt decline between 1981 and 1984, primarily due to the initial construction of nuclear power facilities on the Hanford Reservation by the Washington Public Power Supply System (WPPSS) followed by the rapid curtailment of this activity.

Any substantial economic development will result in the alteration of the structure or size of the local economy. For example, employment and the purchases of goods and services directly related to the repository will likely lead to changes in several economic and demographic characteristics of the Tri-Cities area including total employment, total population, distribution of employment among industrial sectors, geographic distribution of population, total retail sales, geographic distribution of retail sales, and so forth.

The impacts of changes in employment levels on a region depend on the magnitude and timeliness of

corresponding changes in the available workforce. If those who lose jobs when employment declines can find new jobs elsewhere and leave the region quickly, impacts on both those who lost jobs and the labour market as a whole will be less than if outside economic conditions or other factors inhibit their mobility. For example, the WPPSS layoffs were particularly hard-hitting because they occurred at a time when unemployment was increasing statewide and nationally.

POPULATION

Population covaries with employment trends, but the two variables do not exactly coincide as there is always lag time as they adjust to each other. If employment opportunities arise, population will increase; as the employment opportunities dry up, population will decrease. Note that within the total population there are many population components, or identifiable groups or subpopulations, and these are differentially effected by changes in employment and population. This is further complicated by the distribution of the population spatially and the distribution of the total population into distinct groupings.

STUDY AREA(S)

A community-based impact assessment procedure has serious limitations, because the geopolitical boundaries (whether of a community or larger polity) are not isomorphic with the spatial distribution of significant impacts. Neither will impacts within a community be evenly distributed. For this reason, the distinction between "community" and "public" (more properly, "publics" plural), must be made.

There are multiple study areas with geographic referents in the socioeconomic impact study which vary in their scale. In fact, there are six distinct assessment scales that must be considered: (1) primary (local area), (2) multicounty, (3) statewide, (4) regional, (5) national, and (6) international. In addition, there are areal variations within each of the scales. For example, the area of primary employment impacts overlaps with the area of "downstreamers"; each of these areas will experience different sorts of impacts. Such subtlety, however necessary, aside, a brief word about each scale will suffice for the purposes of this presentation.

Primary (local) impact area: This would be composed of the Tri-Cities and adjoining population centers -- in case the vast majority falling within Benton and Franklin Counties.

Multicounty: This would include the commuting range to the Tri-Cities and encompass the people who live outside the Tri-Cities area but use it as a center of activities.

Statewide: Public concern and policy positions concerning the Hanford Reservation are often of statewide propositions, and the State is involved economically and politically with the Federal government on federal activities at the Hanford Site.

Regional: Transportation impacts are the primary concerns at this scale, but downstream and downwind areas are also included here.

National: Federal policy dictates the choice of a single repository with economic, transportation, and policy implications for the entire country.

International: Return transportation of nuclear exports involves impacts risks at the international scale.

As may be seen, a range of scales must be considered although the concentration of impacts would doubtless occur at primary and multicounty levels. This being the case, data must be collected at (or at least disaggregrable to) the smallest analytic scale, in a manner that permits aggregation and comparison at higher levels. Spatial boundaries of the study are variable, but the temporal boundaries are specified more exactly in the study parameters.

DIFFERENTIAL DISTRIBUTION BY GROUP

Impacts will certainly differentially affect at least some of the various ethnic groups represented in the area. For example the Native Americans of the designated affected tribes have a historical and cultural relationship with the land in the area of development that is significantly different from other ethnic groups resident in the area. Other ethnic groups that, like the Native American groups, have distinct social and political attributes are also subject to unique sets of impacts that require analysis. These distinctions must not be lost in the large scope of the long-range analysis. Aggregate analyses must be supplemented to determine the extent to which each of these groups may experience impacts significantly different from the aggregate.

SLIDE PRESENTATION

Base Case: Demographics and Current Employment

During the time period covered by this graphic, 1965-1986, (see Fig. 1), the population of the cities near the Hanford Site has increased dramatically. Population growth or decline obviously covaries with other social indicators, and can precede or follow other indices in response to change; overall population can either be seen as the cause or effect of perceptions of, and reactions to, change. Population in the Tri-Cities area has grown dramatically in response to the economic opportunities, and declined when the opportunities dry up. Typically there is a lag time between economic stimulus and population response and vice versa, and one can track population trends. Whether a new project occurs while the existing population trend is on an

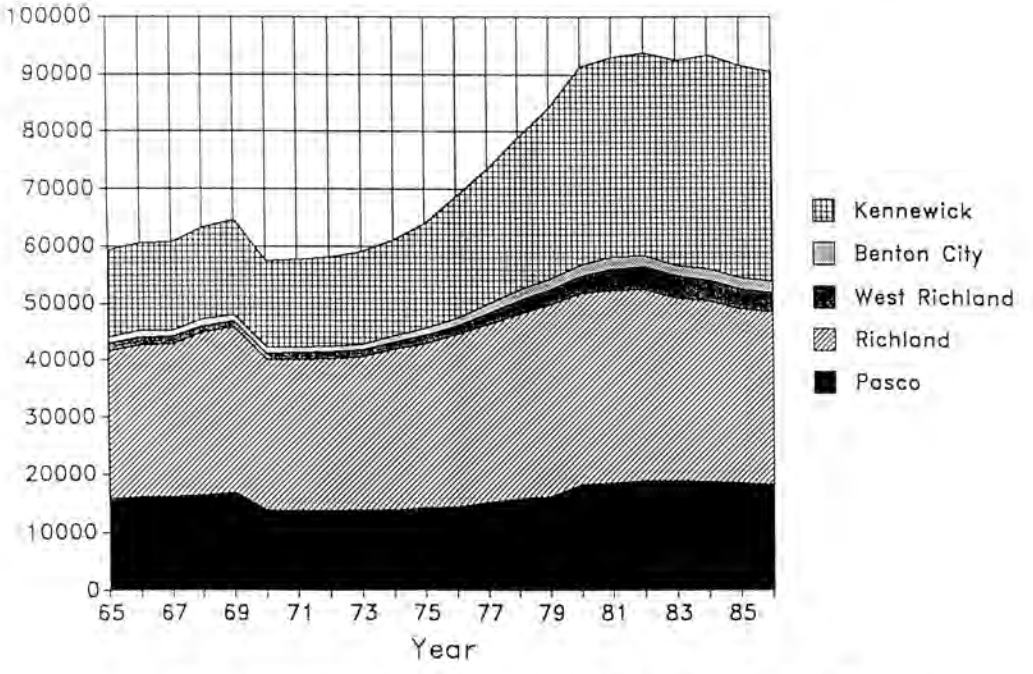

Fig. 1. Population of Cities Near the Hanford Site: 1965-1986.

upward incline, a plateau, or a downward slope, will make a significant difference in the perception of, and response to, the new development. Projects that the population views with ambivalence will be looked upon more favorably, on the balance, during periods of population decline than at times of growth.

Another important consideration is the time frame chosen for analysis. As the graphic shows, the trend for the time frame 1965 through 1986 is a full fifty percent growth, however, if one chooses the smaller time frame of 1979 through 1986 there are peaks and valleys with virtually no net population change. Which time frame is relevant to the local population must be established, and will significantly vary within the population by social group.

On a number of other dimensions the composition of various segments of the population are significant to impact analysis. There will be significant differences between population segments in the utility of opportunities presented by a development project: some will be able to take advantage of particular new opportunities others will not. There will be differential access to particular resources, and it is thus important to note the nature of the population of the area at the time the development takes place and understand the meaning of this differentiation. The different population segments will also vary in their commitment to the area, and it is important to know things such as what resources or opportunities drew them there, what causes them to remain, or will cause them to leave, and how does the project fit into the scheme of things?

The same sorts of distinctions may be made between communities in the area. Kennewick has grown in absolute numbers much faster than the other cities, and is at the top in relative numbers as well. Expectations will be framed in current contexts in each of the cities as well as within each of the population segments.

This graphic sets the employment context of the period 1967 through 1986 (see Fig. 2). In addition to showing the overall employment, it displays employment by economic sector. This allows a depiction of the employment trend context of development events and allows inferences about the occupational composition of the area's population. The sectors extant, and their relation to the new development, will be critical to the analysis of what types of impacts will likely be generated. It is essential to know the training of the people in the area, and whether they will be able to take advantage of the new opportunities, or if they will see it as a threat to their present employment. Is the new development complementary or incompatible with the present employment structure? Another critical dimension is the relation of the level of employment and the level of the population of the area.

In spite of efforts to diversify, the economy of the Tri-Cities has remained primarily dependent on the level of activities on the Hanford Reservation (see Fig. 3). The Tri-Cities have experienced boom and bust phenomena in standard impact variables in a variety of ways because of the local association with federal nuclear projects, and the

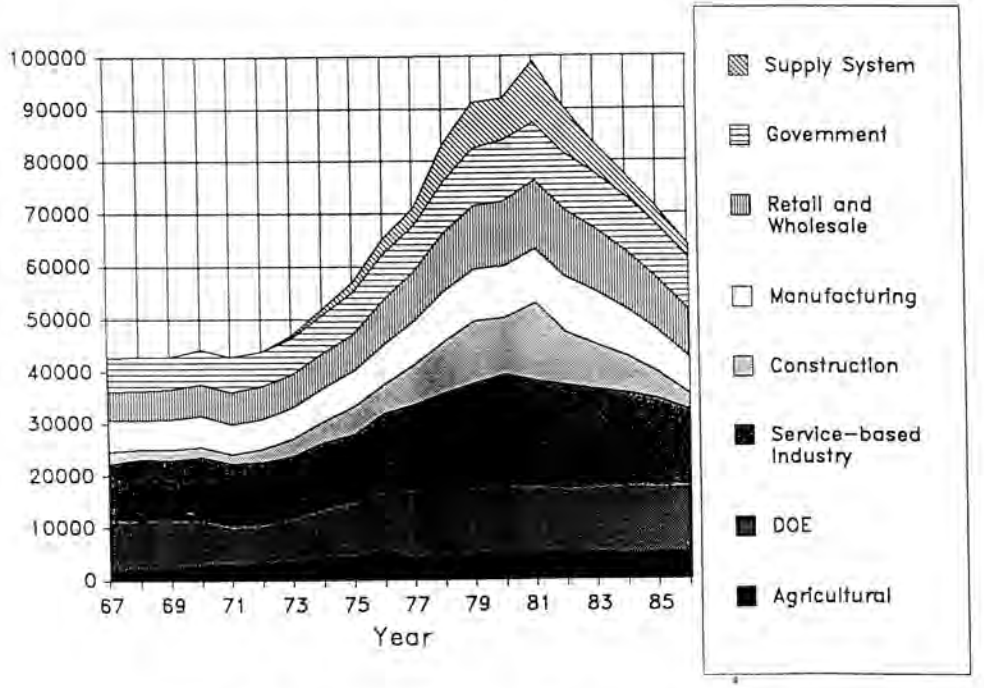

Fig. 2. Benton/Franklin County Employment: 1967-1986.

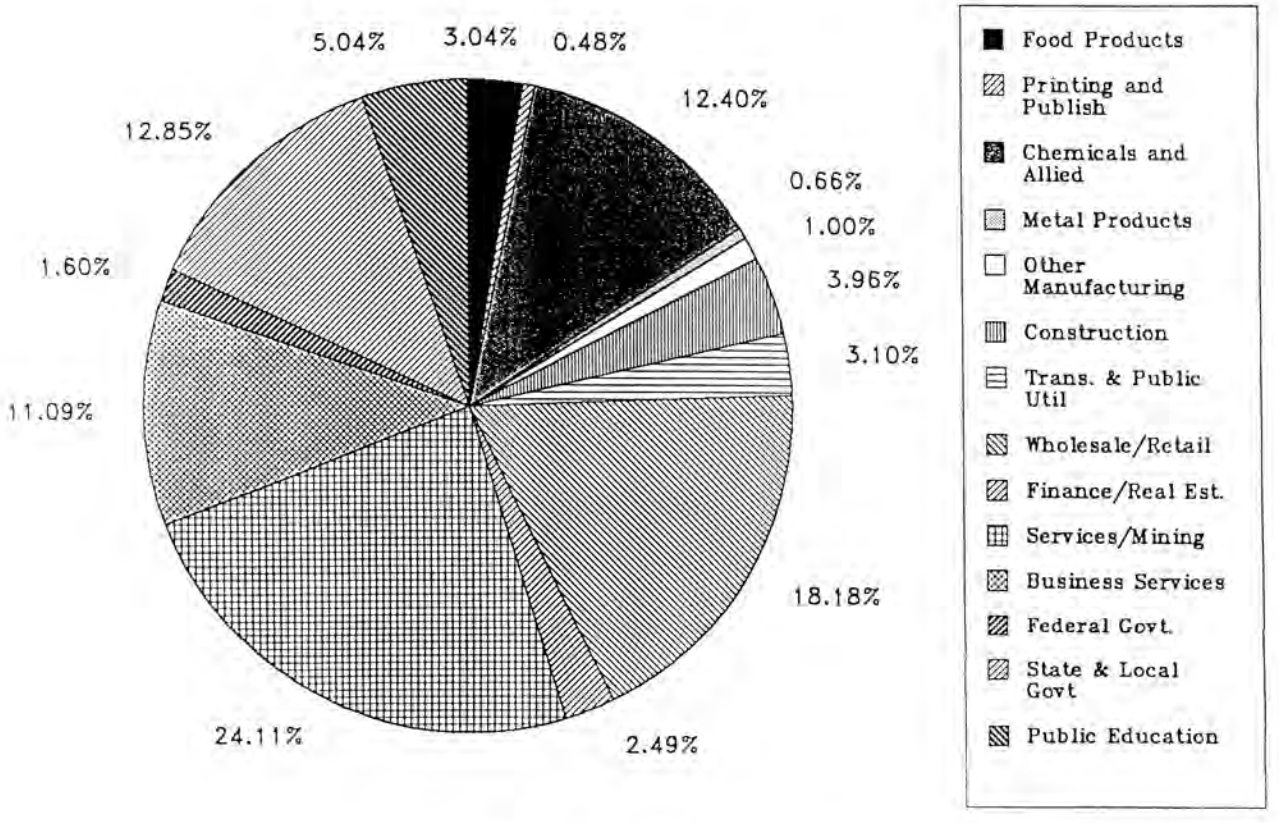

Fig. 3. Tri-Cities Economy.

volatile nature of political and financial support for these projects.

It is essential to understand the context of the proposed development in terms of the overall economic picture, and not just employment. This graphic illustrates the relative size of the sectors of the economy and the diversification of the economy. It is important to know whether the new development will represent a broadening of the economic base and a diversification of the economy, or whether the new development will further narrow the base of the local economy to the effect that otherwise minor perturbations in the focus of the economic base will cause wide disruption.

These graphics illustrate the location specific employment context in terms of wages, and allows interpretation of what relative impact an increase or decrease in payrolls would have on the county wide level (see Figs. 4 and 5). Both Benton and Franklin counties are illustrated and the relative size of their economic bases is readily apparent.

This graphic illustrates the relative role of Hanford employment to the overall employment context (see Fig. 6). As is easily seen, Hanford employment accounts for a very significant portion of the employment in the area. Hanford employment is composed of a number of different sectors, and the proposed development would add to this overall figure. To a large extent, it is likely that the general public will not differentiate the new project employment from other Hanford employment, as there appears to be a good deal of cognitive lumping. That is to say, there is a long history of nuclear-related projects in the area, and many people do not clearly differentiate the distinct projects.

As seen in the previous graphics, nearly 27% of the Tri-Cities employment is comprised of Hanford employment, a very large percentage indeed (see Fig. 7). However, as can be seen by this graphic, the relative role of Hanford wages in the Benton/Franklin county economies even larger, accounting for over 45% of the wages. Obviously, the reason for this is that Hanford jobs are relatively well paying, and indicates a degree of dependency on Hanford beyond what employment statistics would indicate. Further additions to what is, in many senses, a single employer would obviously have different impacts than the addition of those same number of jobs in another sector of the economy, both in terms of additional wages generated and economic diversification.

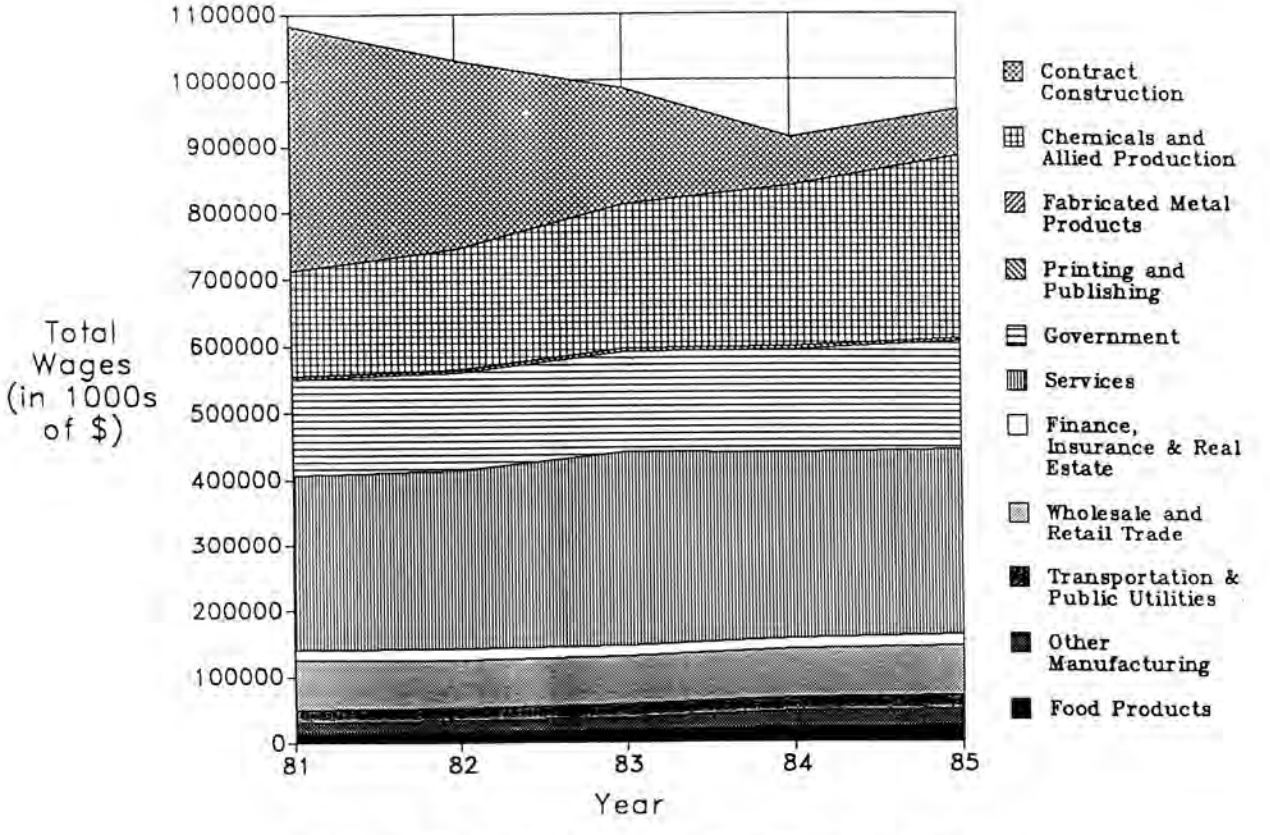

Fig. 4. Non-Agricultural Payrolls: Benton County, 1981-1985.

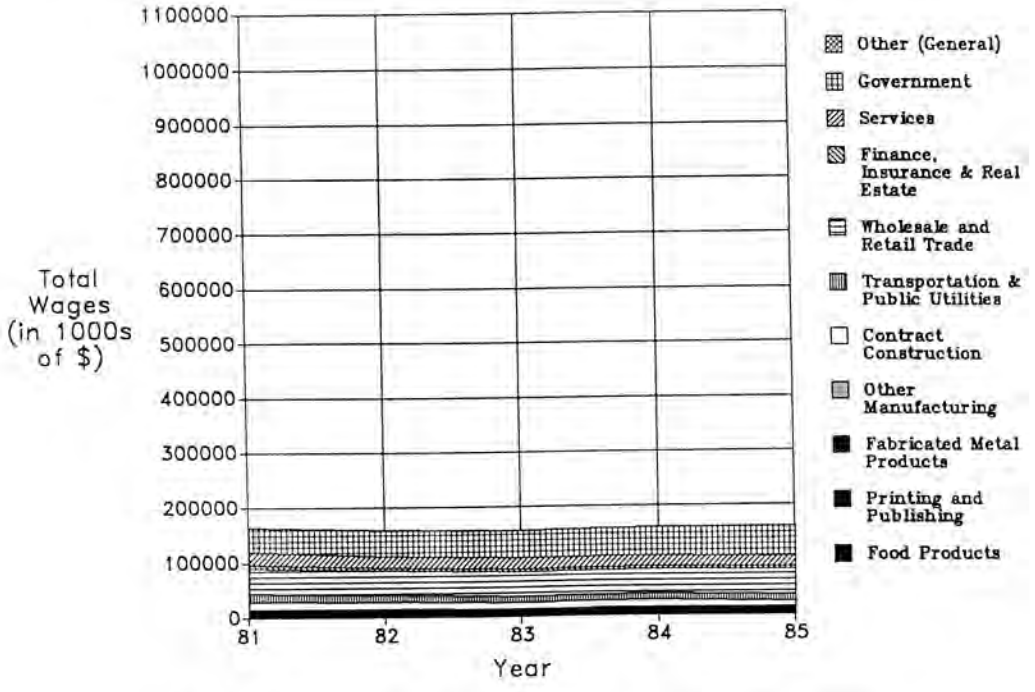

Fig. 5. Non-Agricultural Payrolls: Franklin County, 1981-1985.

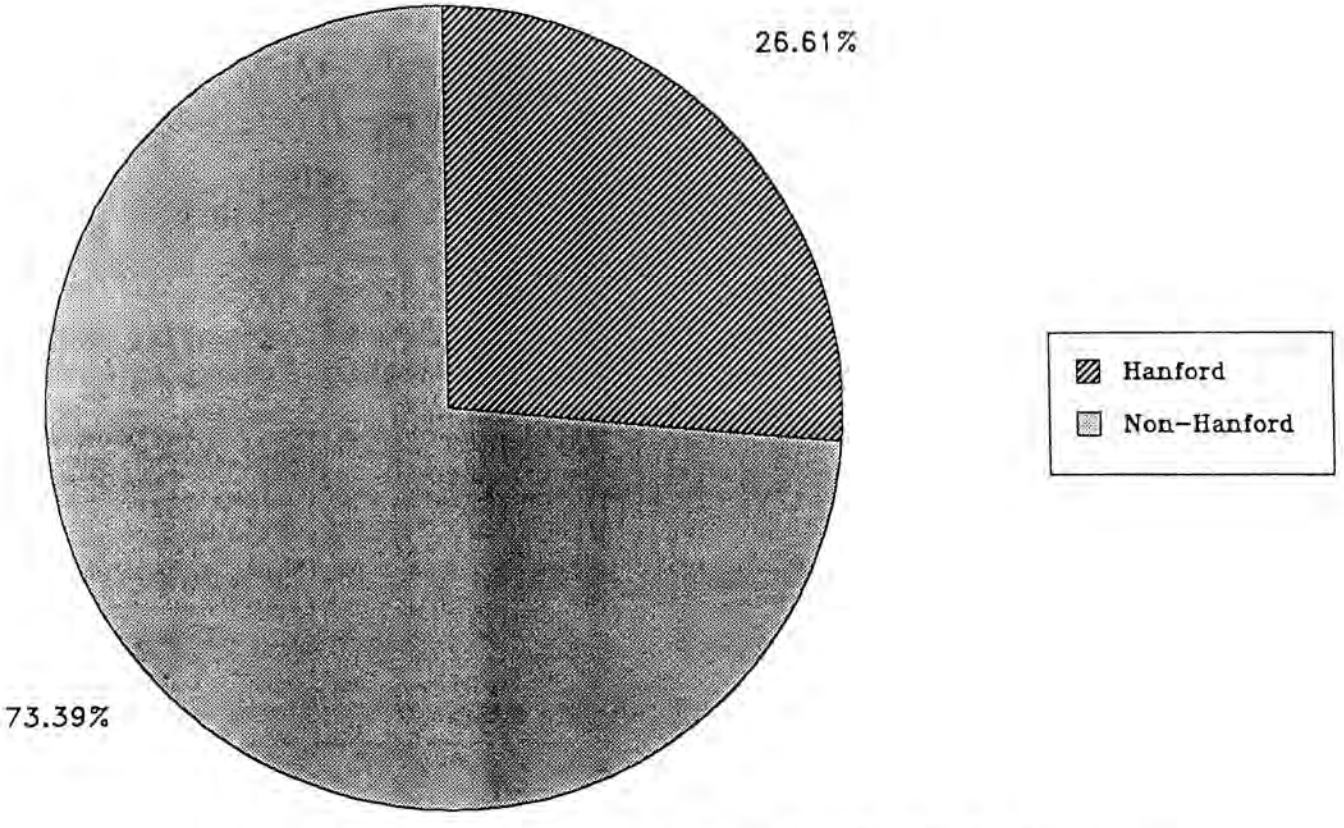

Fig. 6. Relative Role of Hanford Employment to Total Tri-Cities Employment.

BASELINE: THE DEVELOPMENT OF ALTERNATIVE FUTURE PROJECTIONS

As mentioned above, there are a number of difficulties associated with the development of baseline projections. It must be kept in mind that there are a number of things that can happen, in varying combinations, over the years of a baseline projection, and that any major change in the context will result in very different impacts for the same event. (Not to mention the fact that we are talking about a very long period of time -- in the long term scenarios a time span equal to nearly half of the history of our country -- and there are things that will happen socially and technologically that we can't possibly imagine.) There are an array of futures that we can anticipate. In the end what is needed is multiple futures planning, and a monitoring program in place to track the context and the change.

HANFORD CUMULATIVE EMPLOYMENT GRAPHICS MEDIUM-TERM SCENARIOS (40 YEAR)

Our "Worst Case Scenario" is based upon the N Reactor not restarting, and actually contains three variations on this theme. (PUREX operations are tied to the N Reactor, and changes at PUREX will co-vary with changes at N Reactor.) Obviously, there are a number of different ways that a project can close down, and what I will describe next are three general ways that projects are often terminated: (1) a "stepped" phase-out period, (2) a gradually "sloped" phase-out period, and (3) an "abrupt" phase-out period. These three types of phase-out have quite different effects on the community.

"STEP" PHASE OUT OF THE N REACTOR

Under this set of assumptions, N Reactor employees are terminated at two distinct rates beginning at two points in time, or in stepped phases (see Fig. 8). This would generate impacts in three distinct modes (separated in time) within the community and region. This phaseout profile also determines the stepped curve of the phaseout of the interrelated PUREX plant.

"LEVEL" PHASE-OUT OF THE N REACTOR

Under this set of assumptions, N Reactor employees are terminated at a steady, gradual rate over the course of the phaseout activities. Under these conditions, the local economy and population would adjust to a single mode of reduction. This phaseout profile of the interrelated PUREX plant also follows a shallow-sloping curve.

"ABRUPT" PHASE-OUT OF THE N REACTOR

Under this set of assumptions, N Reactor employees are terminated abruptly, early in the phaseout process. Under these conditions, the local economy and population would adjust to what amounts to a sharp drop in the job market. Under these assumptions, the phaseout profile of the interrelated PUREX plant is much steeper, and earlier than under the other assumptions.

HANFORD CUMULATIVE EMPLOYMENT GRAPHICS LONG-TERM SCENARIOS (40 year)

The following are several graphics which illustrate the addition of other variables to the baseline (see Figs. 11-20).

CONCLUSION

It has been the intent of this paper to emphasize the need to accurately contextualize socioeconomic impacts in order to understand how they will be perceived and acted upon by local populations. The complexity of local populations and the differential spatial and subpopulation distribution of impacts must also be dealt with. In order to illustrate these problems, a number of baseline scenarios from the Hanford Site were presented. It is suggested that any form of impact analysis that extends over a significant span of years needs to have built-in provisions for monitoring the context of the development and the impacts of the development as they change through time.

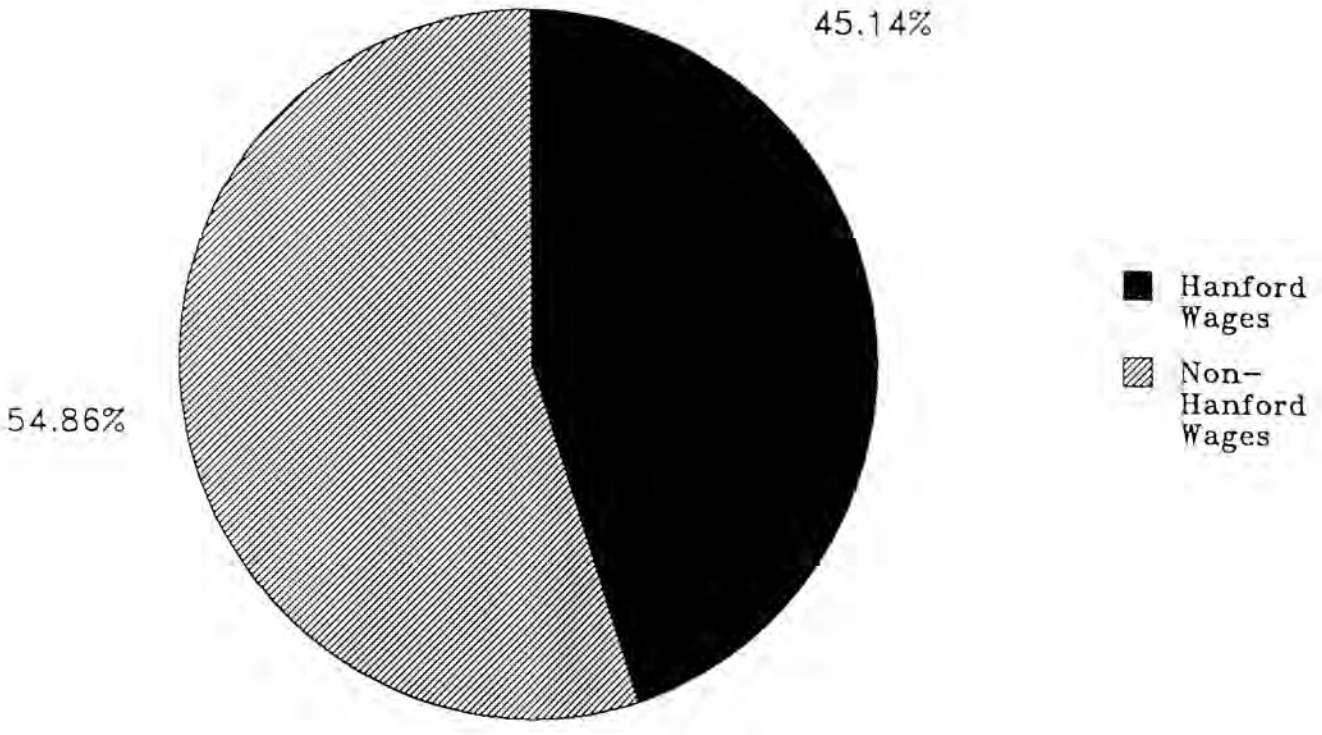

Fig. 7. Role of Hanford Wages in Benton/Franklin Economies:1985.

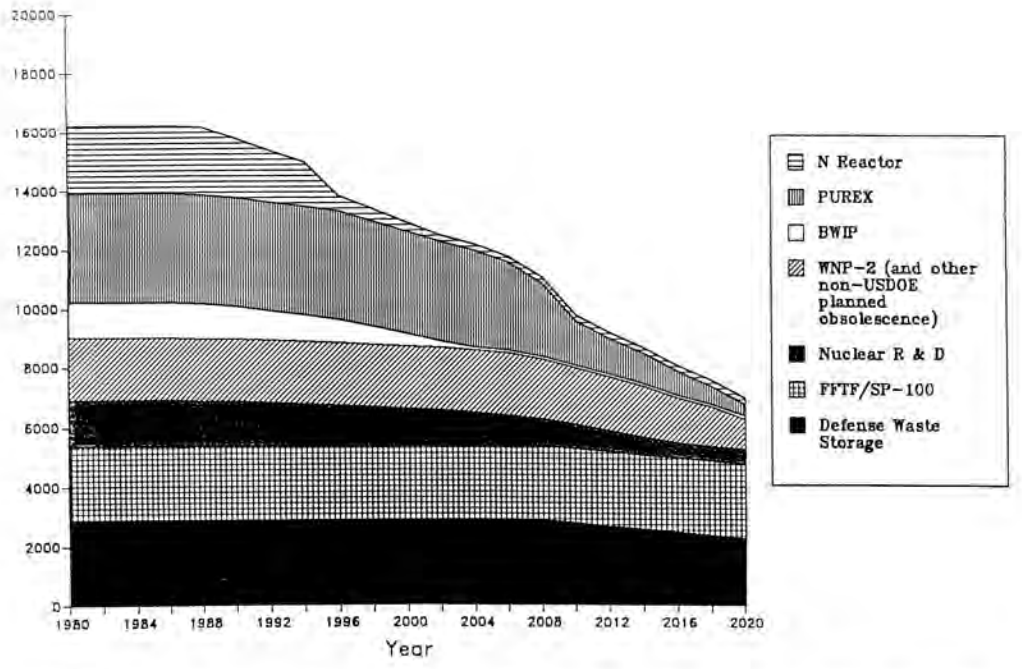

Fig. 8. Hanford Cumulative Employment Picture Worst Case Scenario (1): 1980-2020.

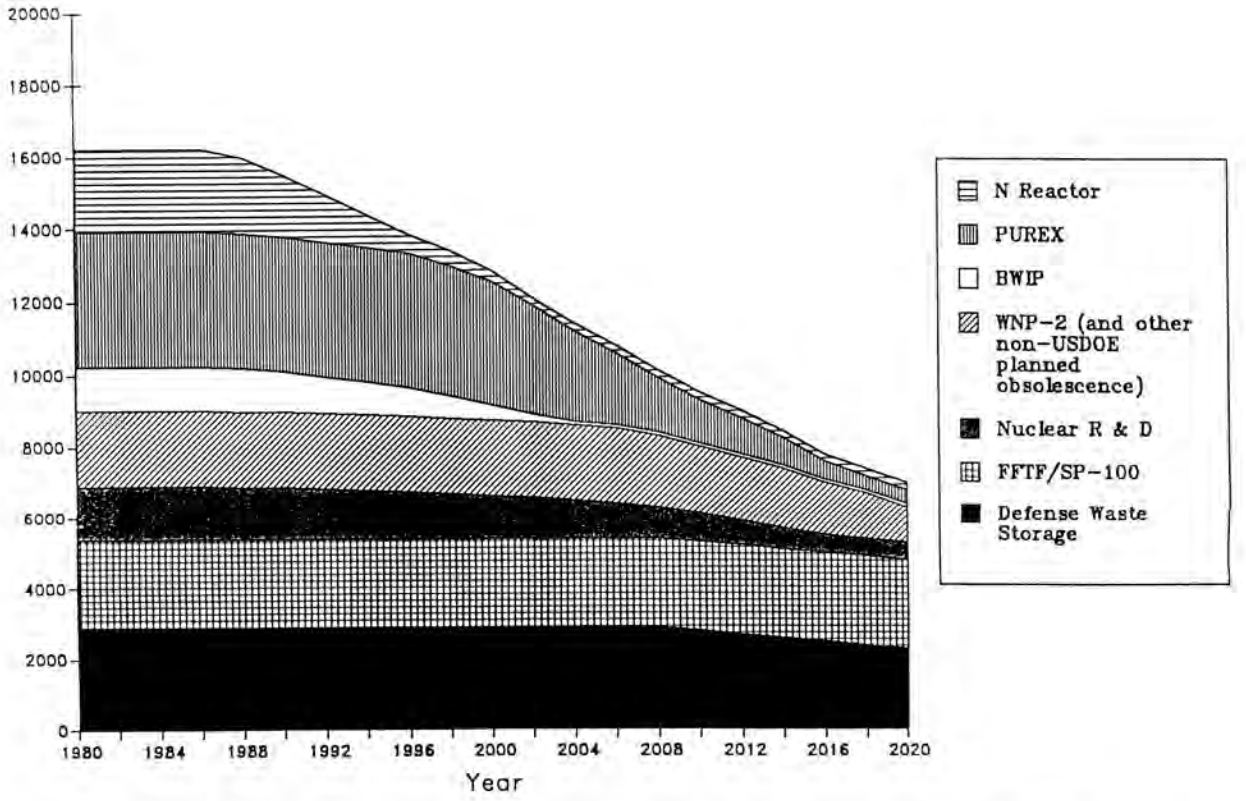

Fig. 9. Hanford Cumulative Employment Picture Worst Case Scenario (2): 1980-2020.

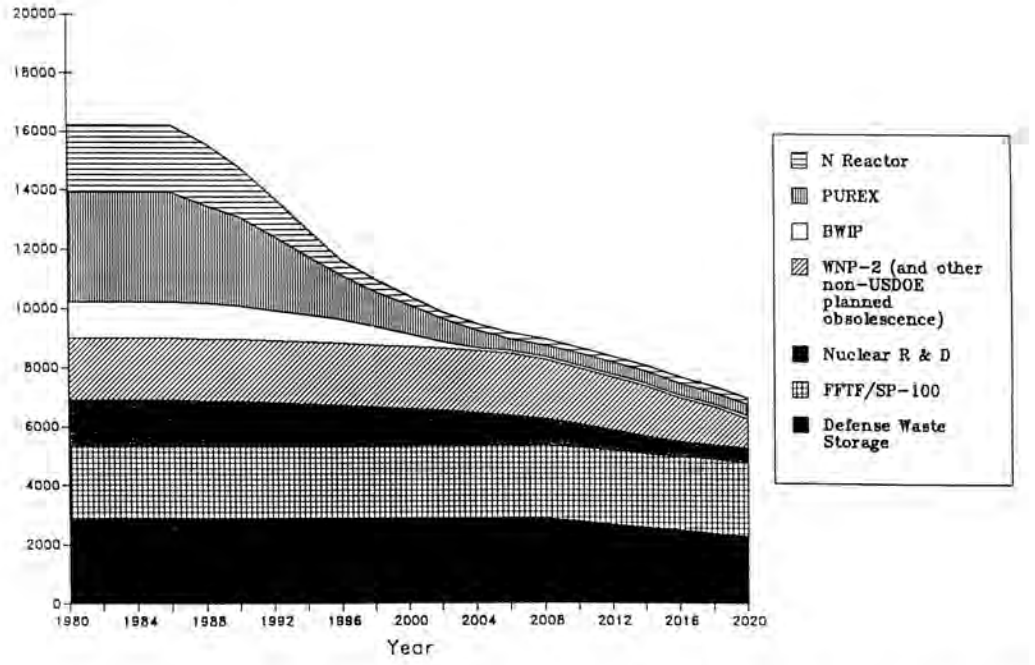

Fig. 10. Hanford Cumulative Employment Picture Worst Case Scenario (3): 1980-2020.

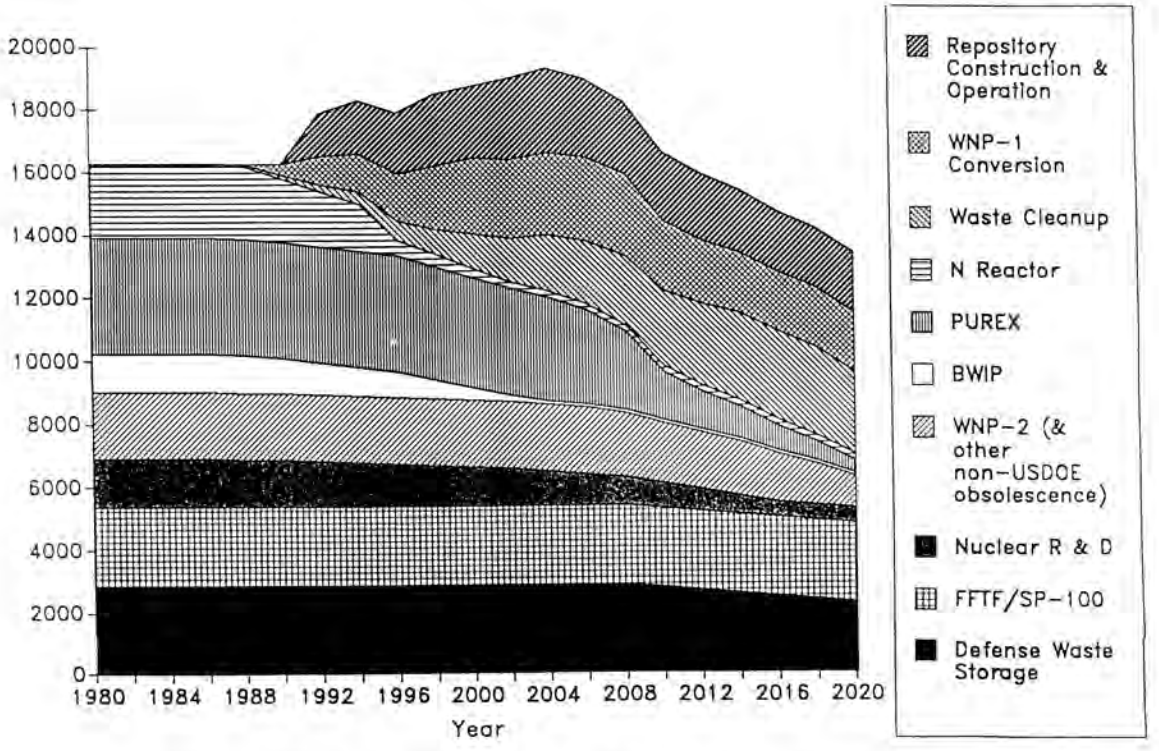

Fig. 11. Hanford Cumulative Employment Worst Case (1), Defense Waste Cleanup, WNP-1, & Repository Activities: 1980-2020.

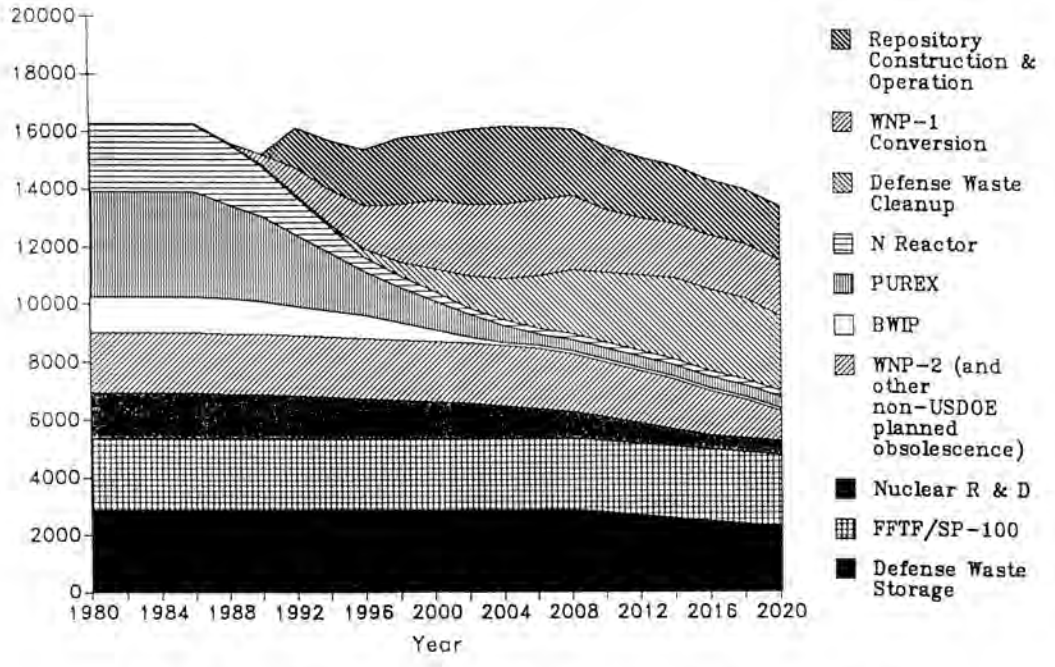

Fig. 12. Hanford Cumulative Employment Worst Case (3), Defense Waste Cleanup, WNP-1, & Repository Activities: 1980-2020.

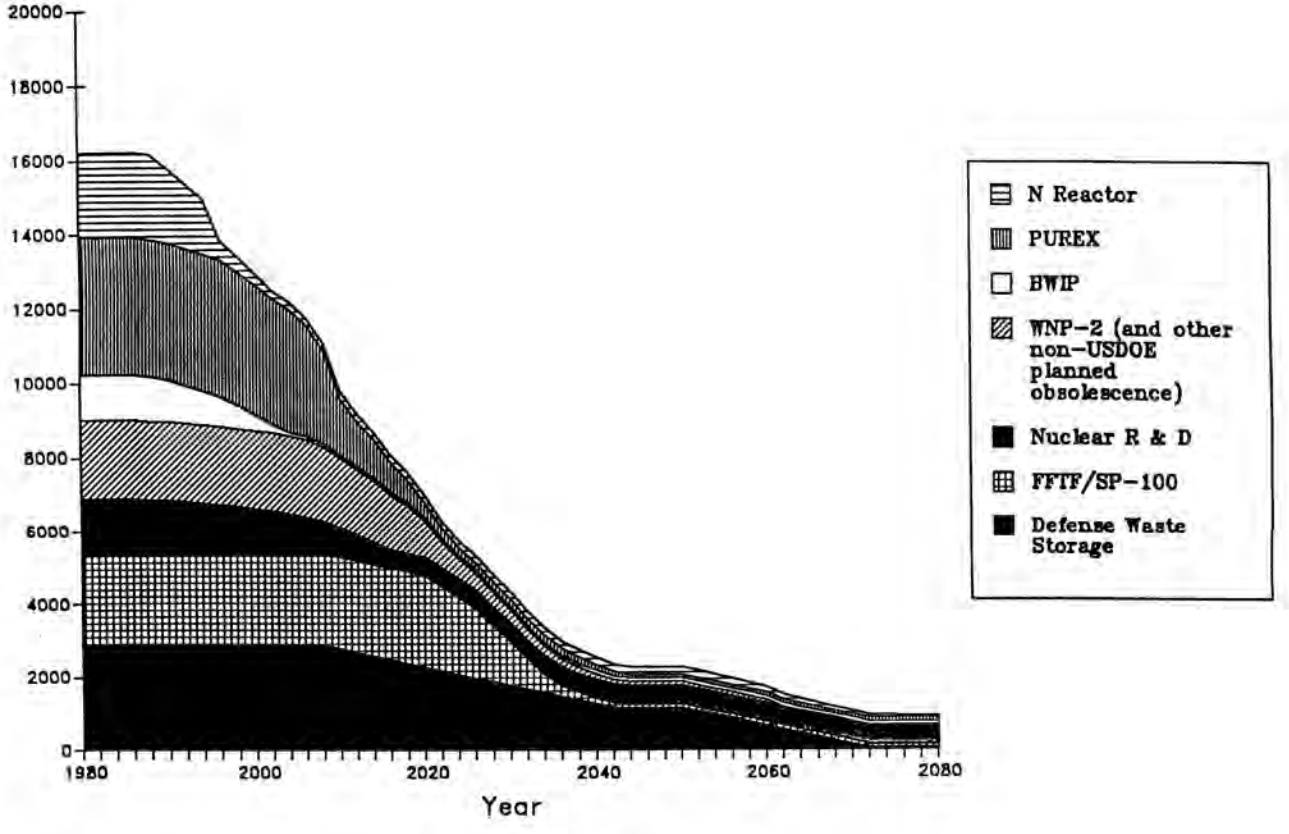

Fig. 13. Worst Case Scenario: 1980-2080.

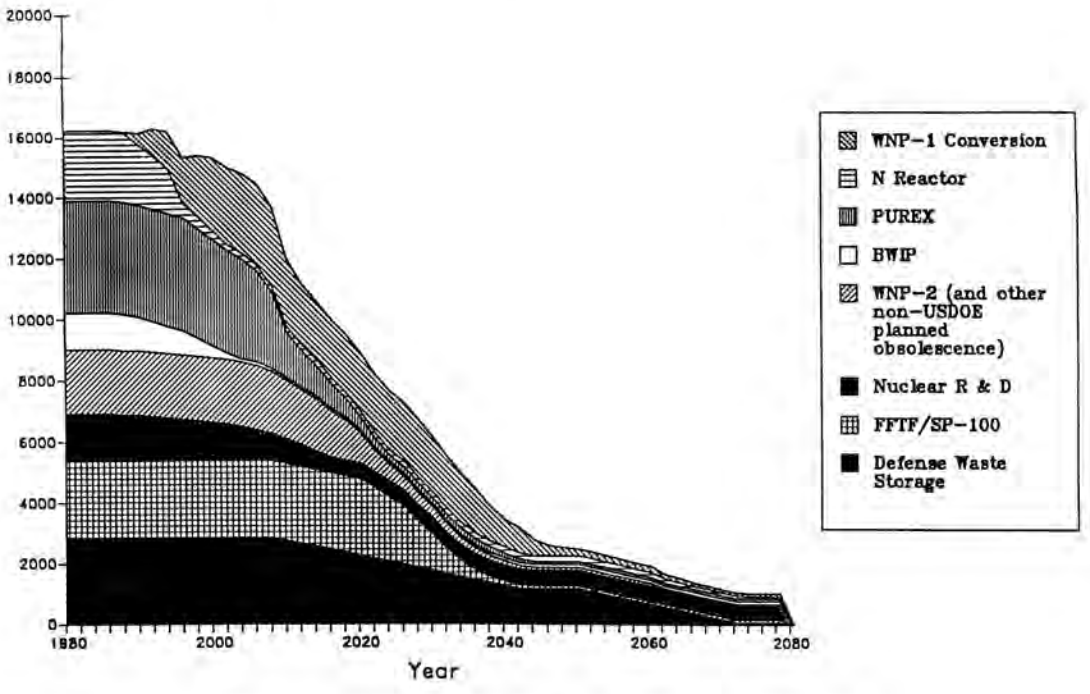

Fig. 14. Worst Case Plus WNP-1 Conversion: 1980-2080.

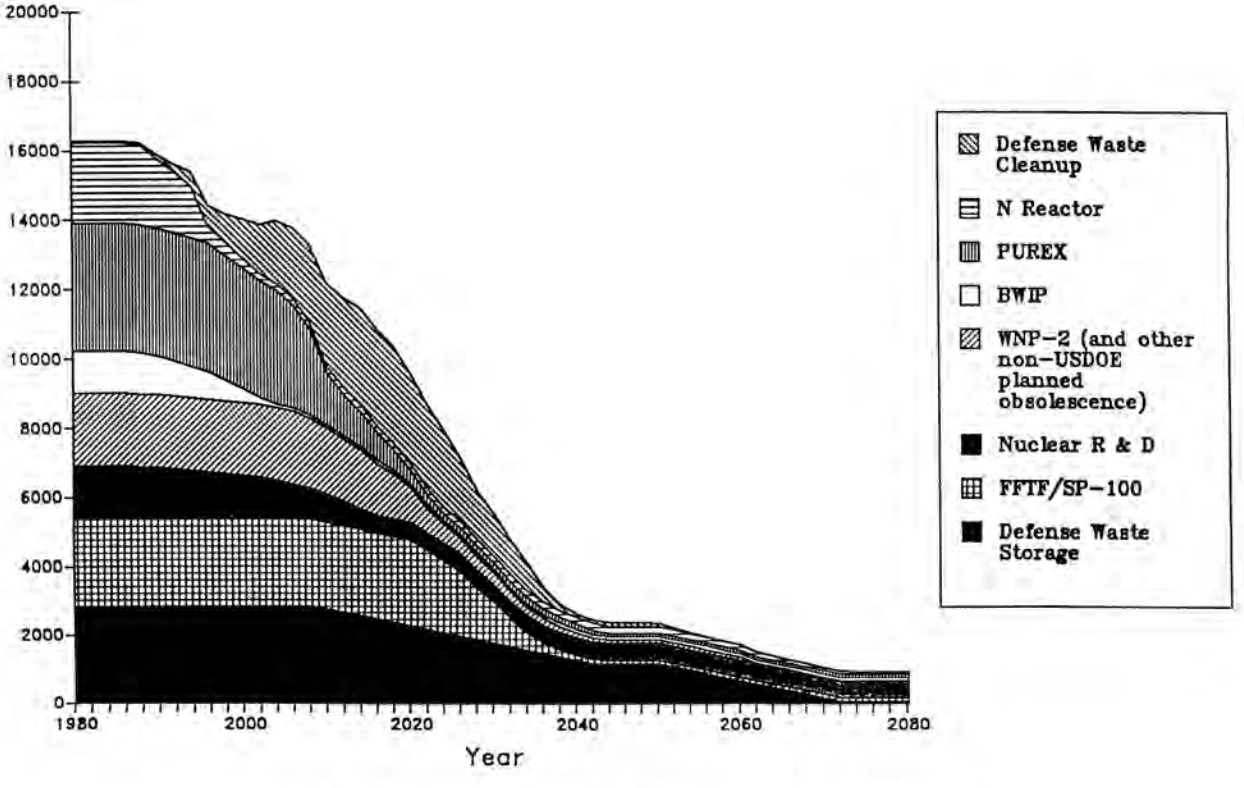

Fig. 15. Worst Case Plus Defense Waste Cleanup: 1980-2080.

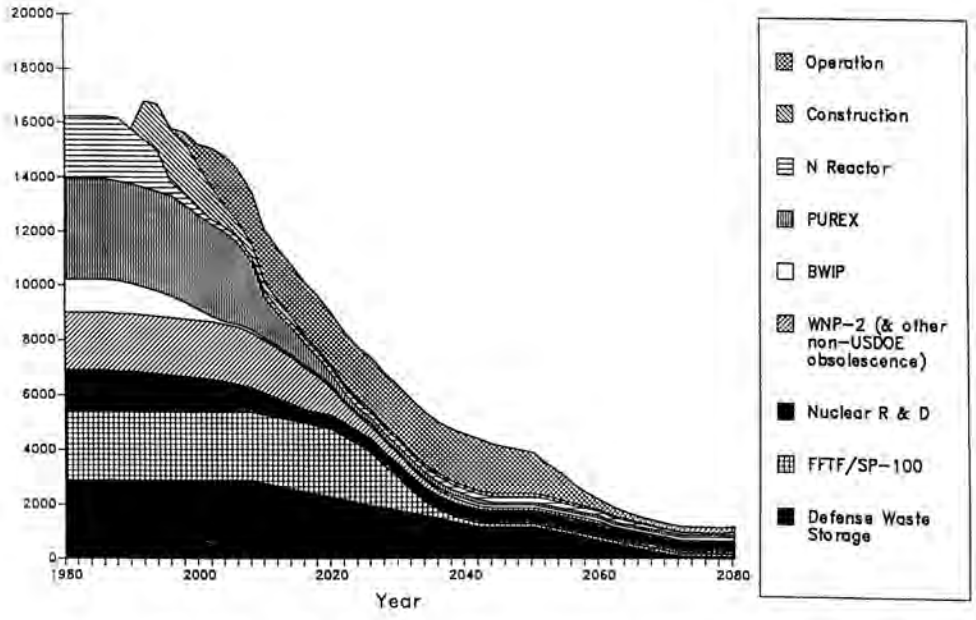

Fig. 16. Worst Case Plus Repository Construction and Operation: 1980-2080.

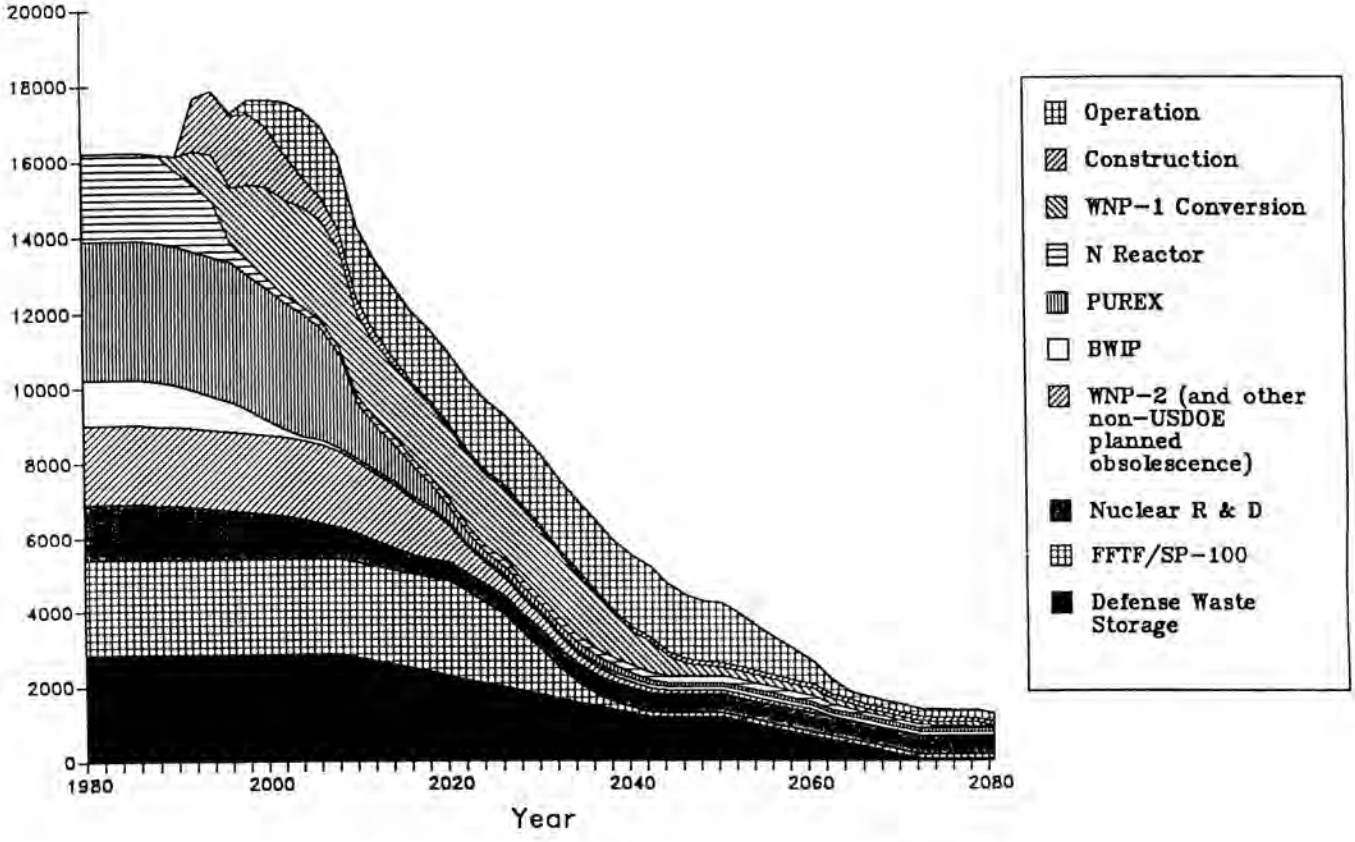

Fig. 17. WNP-1 Conversion and Repository: 1980-2080.

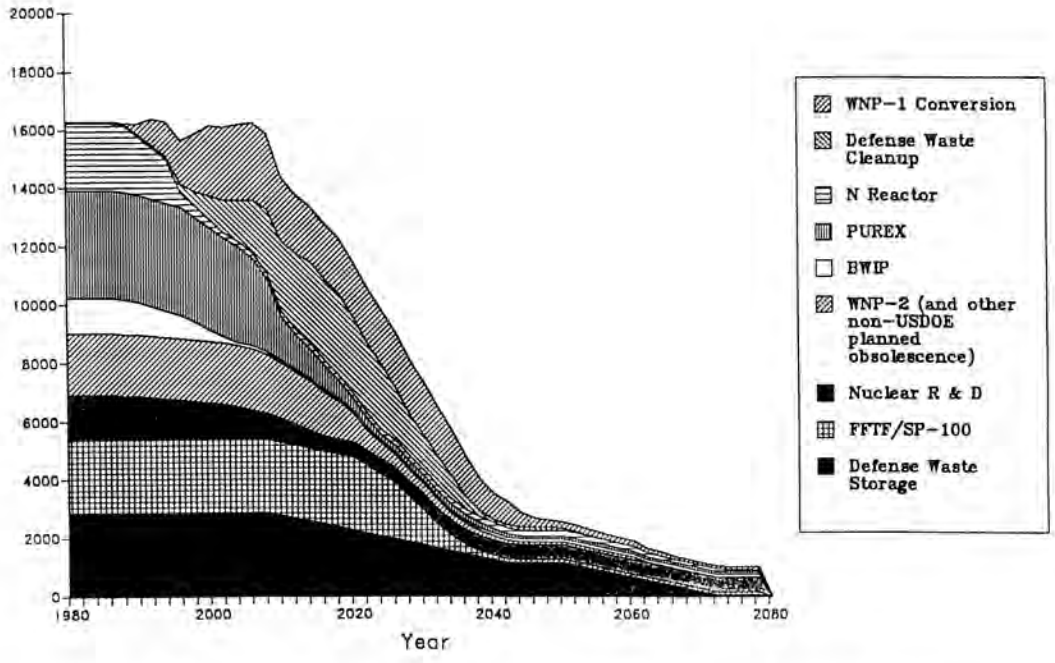

Fig. 18. Defemse Waste Cleanup and WNP-1 Conversion: 1980-2080.

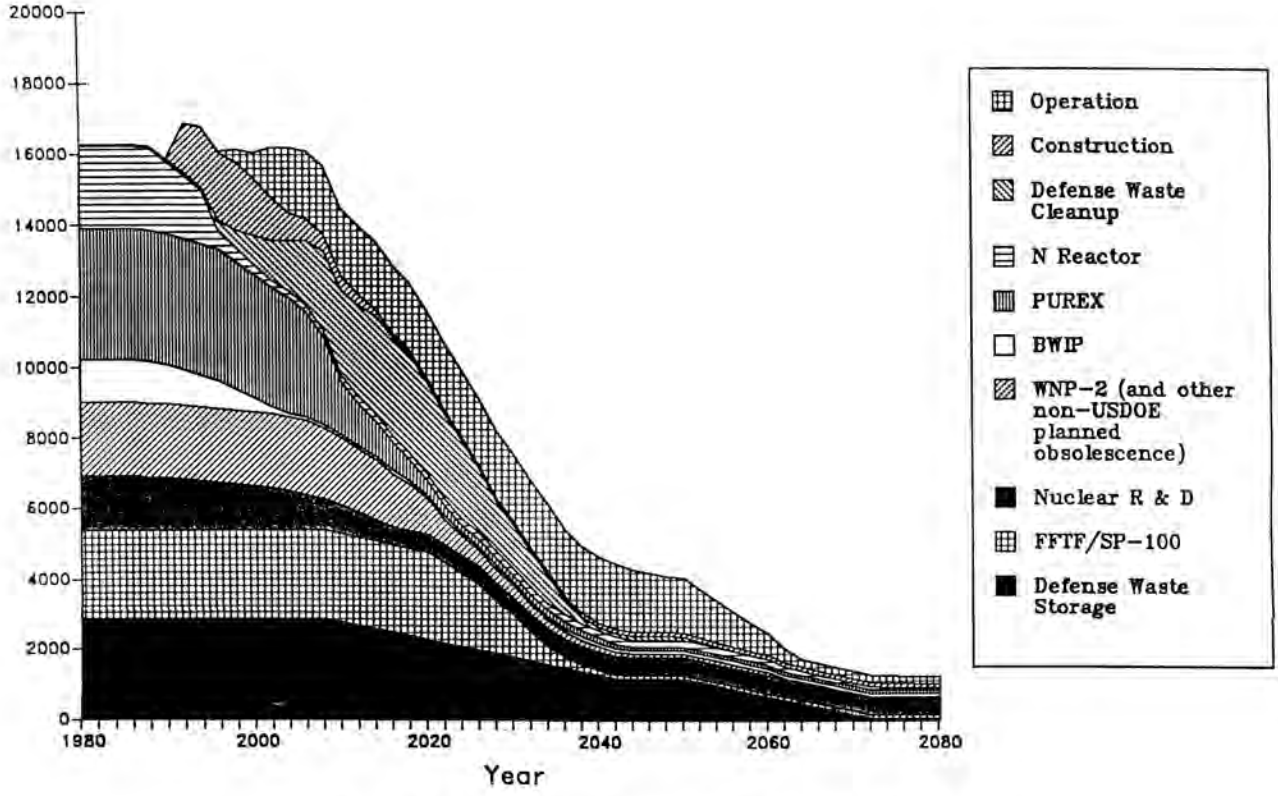

Fig. 19. Defense Waste Cleanup and Repository: 1980-2080.

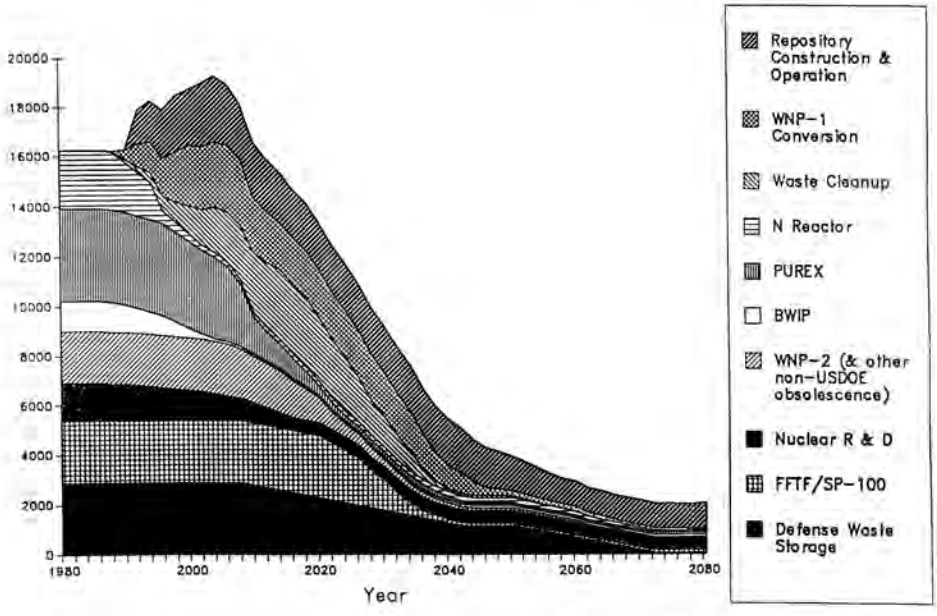

Fig. 20. Defense Waste Cleanup, WNP-1 Conversion, and Repository: 1980-2080.