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Determining Patterns of Reserve Attrition Since September 11, 2001

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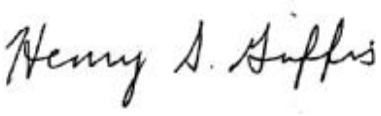

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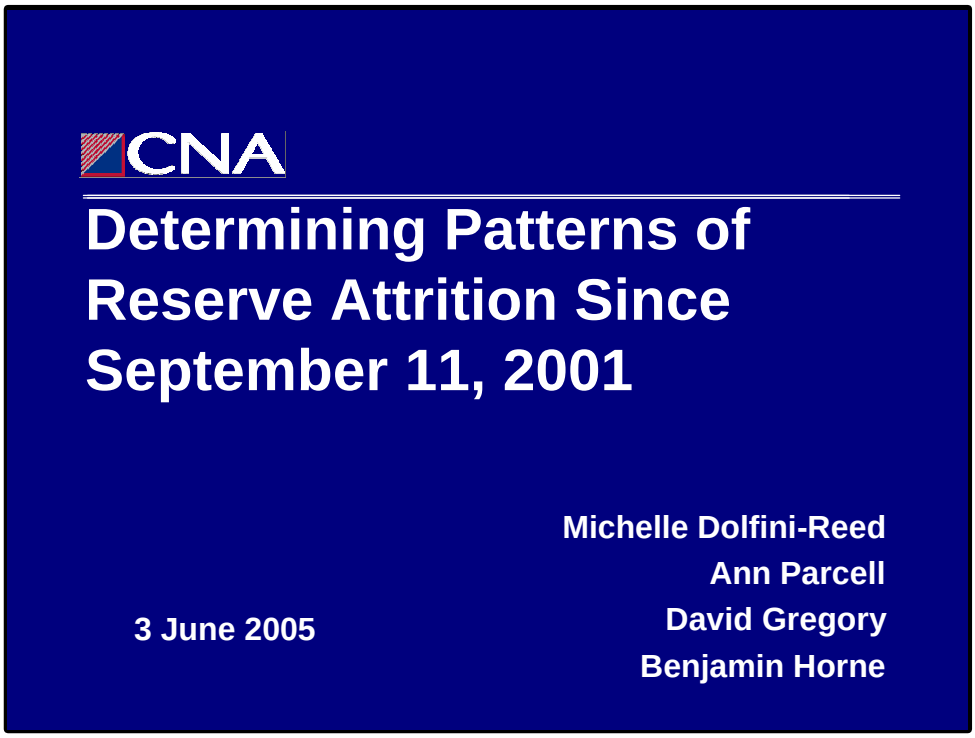


The ongoing presidential callup of the Reserves to support Operation Noble Eagle (ONE), Operation Enduring Freedom (OEF), and Operation Iraqi Freedom (OIF) has brought Reserve issues to the forefront of military policy concerns. In the post-cold-war era, this callup represents the second major use of the Reserve Forces. However, unlike the Reserve callup in 1990 supporting Operation Desert Shield/Desert Storm (DS/DS) which lasted less than 1 year, this mobilization has lasted much longer—nearly 4 years to date. Policy-makers are concerned that the duration and nature of this mobilization may contribute to increased losses from the Reserves and difficulties in meeting accession goals. Other than Desert Shield/Desert Storm, there is no recent comparable experience and corresponding empirical evidence on Reserve behavior under such circumstances. Our goal is to provide the Deputy Assistant Secretary of Defense for Reserve Affairs (Manpower and Personnel) with empirical information on patterns of losses in the Reserves since September 11, 2001.

Study goals

- Create a database that tracks reservists' activation experiences
- Assess, to the extent possible, the impact of mobilization, activation, and deployment on losses
- Investigate ways to model Reserve losses

Before undertaking our investigation of Reserve losses since the callup following 9/11, we created a database that allows us to track members of the Selected Reserves (SelRes) since fiscal year 2000. We use this database to assess the impact of mobilization, activation, and deployment on Reserve loss rates, using descriptive statistical techniques. In the first half of this annotated briefing, we present the results of our analysis of loss behavior for enlisted members of the SelRes.

However, a descriptive perspective provides only a partial picture of Reserve loss behavior and does not allow us to take into account the relationship between multiple factors and Reserve losses. In addition, in the process of doing the analysis, we became aware of a number of technical issues that complicate comparisons of loss behavior of reservists who are activated, those who are activated and deployed overseas, and those who are never activated. Addressing these issues requires a model of Reserve loss behavior. We were not able to fully and directly tackle the task of conducting a multivariate analysis of Reserve losses; however, we did investigate potential ways to model Reserve losses, and we provide our thoughts on this matter, as well. We discuss these issues in the second half of this document.

Findings: Enlisted SelRes loss rates since 9/11….

- Are higher than FY 2000 comparison rates
- Fluctuate over time by activation and deployment status
- Are higher for those who were activated but not deployed compared with those who deployed
- Tend to increase with length of active duty period; furthermore, along this dimension loss rates are
  - lower for those who deploy and
  - higher for those who were activated and stayed in CONUS
- Are similar for those with multiple completed activations and those with one activation

Because we are attempting to connect loss behavior to an active duty period, we calculate 6-month loss rates following the end of an enlisted SelRes member's activation. We find that enlisted SelRes loss rates consistently are higher than loss rates in FY 2000, although they have fluctuated over time by activation and deployment status. In addition, when stratified by deployment status, SelRes loss rates are higher for those who were activated but not deployed compared with those who deployed.[1]

Loss rates for activated enlisted SelRes members also tend to increase as their length of time on active duty increases. This pattern tends to hold when we stratify loss rates by deployment status. Finally, we find that loss rates do not vary much by the number of completed activations.[2] Loss rates for SelRes members with one activation tend to be similar to loss rates for those serving two or more active duty periods. These findings suggest a preference among reservists to serve shorter active duty periods in settings outside CONUS (OCONUS), which in turn places less long-term stress on the reservist's family and civilian-based employment responsibilities.

[1] We classify reservists as "deployed" if they are sent to support a contingency outside the continental U.S (CONUS); otherwise, we classify members as "activated but not deployed."

[2] We provide caveats to this finding in our analysis section.

Creating the Reserve losses database

- Used SelRes records from end-of-month Reserve Component Common Personnel Data System (RCCPDS)
  - Focus on all nonactivated SelRes as of Sep '01
  - Also include SelRes accessions since Oct '01
  - Exclude Active Guard/Reserve (AGRs)
- Determined activation/deployment status from Defense Manpower Data Center's (DMDC) monthly contingency file
  - Must be 30+ days on active duty
  - Completed active duty periods: must be activated and deactivated by July '04
  - Multiple completed active duty periods: use only last active period
- Matched monthly RCCPDS and monthly activation files (Sep '01 – Jan '05)

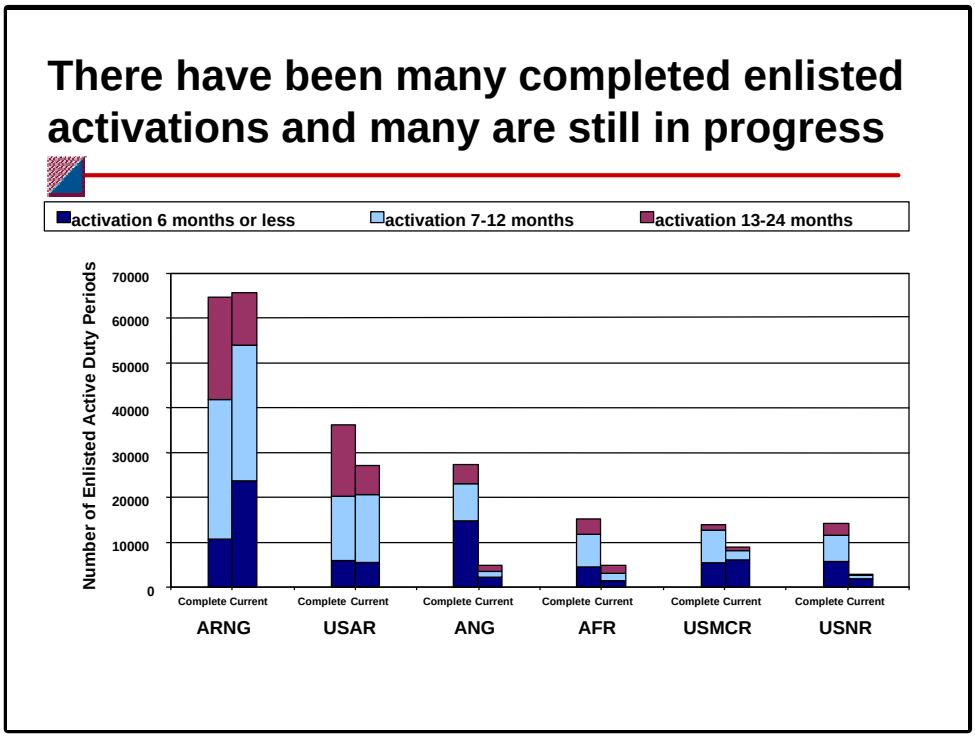
We created our Reserve losses database from the RCCPDS and DMDC's contingency file. The RCCPDS provides a single electronic source of Reserve component information. We use the RCCPDS monthly snapshots from October 1999 through January 2005. From these files, we define our population of interest as all enlisted SelRes members who were not activated as of September 2001 or who joined the SelRes since October 2001. We exclude those enlisted SelRes members who were on Active Guard/Reserve (AGR) status.[3]

Next, we classify all enlisted SelRes members as either "never activated" or "activated" over the entire time period. We use DMDC's contingency file to determine each member's activation status. The contingency file provides a single source of information on all active and reserve component members who have been activated more than 30 days, including whether they have deployed to support a named contingency, such as OEF or OIF, since September 2001. SelRes members who are activated are under stop-loss orders and cannot leave the SelRes until they are deactivated. We further classify activated enlisted SelRes members as follows:

- As a "completed activation" if deactivated by July 2004 or
- As "currently activated" if still on active duty as of July 2004.

We also are interested in knowing whether there are differences in SelRes loss rates by deployment status. Therefore, we categorize activated SelRes members as either "activated and deployed" or "activated and not deployed." Finally, if a member has completed more than one active duty period from October 2001 through July 2004, we use only the last active duty period in calculating the loss rate.

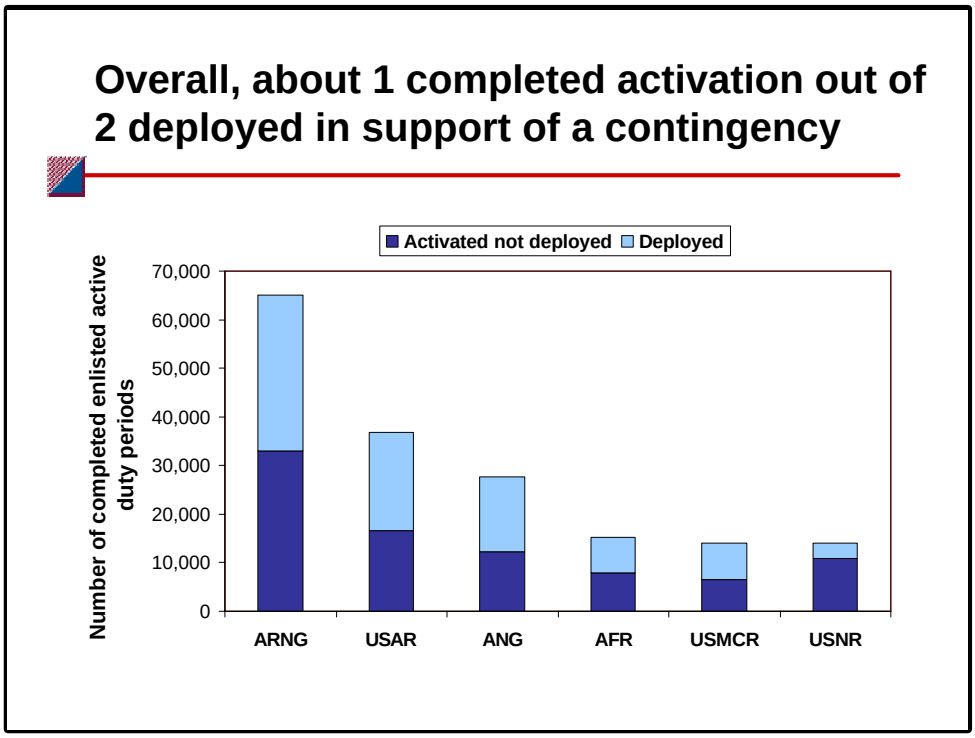
[3] AGRs are National Guard or Reserve SelRes who are ordered to active duty or full-time National Guard duty to organize, administer, recruit, instruct, or train the Reserves.



As of July 2004, there had been many completed enlisted activations and more were still in progress. Almost 173,000 members of the enlisted SelRes had completed at least one active duty period, while nearly another 116,000 were still on active duty. In the table above, we show the distribution of completed and current activations by length of active duty period by Reserve component. Overall, the Army National Guard (ARNG) and the U.S. Army Reserve (USAR) are providing the greatest number of SelRes members to support ongoing military operations in CONUS and abroad. Current activations are particularly concentrated in the ARNG and the USAR. The USAR, Air National Guard (ANG), Air Force Reserve (AFR), U.S. Marine Corps Reserve (USMCR), and U.S. Naval Reserve (USNR) have a greater number of SelRes members with completed activations than currently activated in July 2004.[4]

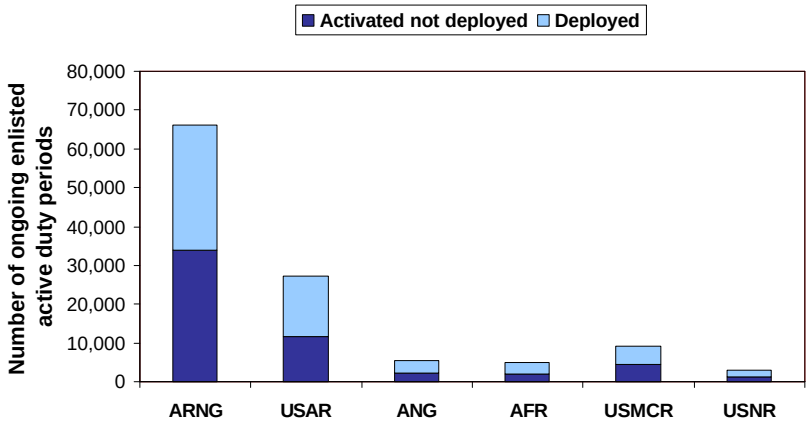
The length of the activation period tends to be longer (13-24 months) for members of the ARNG and USAR for both those with completed activations and those whose activation periods are ongoing. In comparison, shorter activation periods of 6 months or less or 7-12 months tend to be most common among those with activations in the ANG, AFR, USMCR, and the USNR.

[4] We do not report information on the Coast Guard Reserve in this annotated brief because of its small size and data integrity issues.



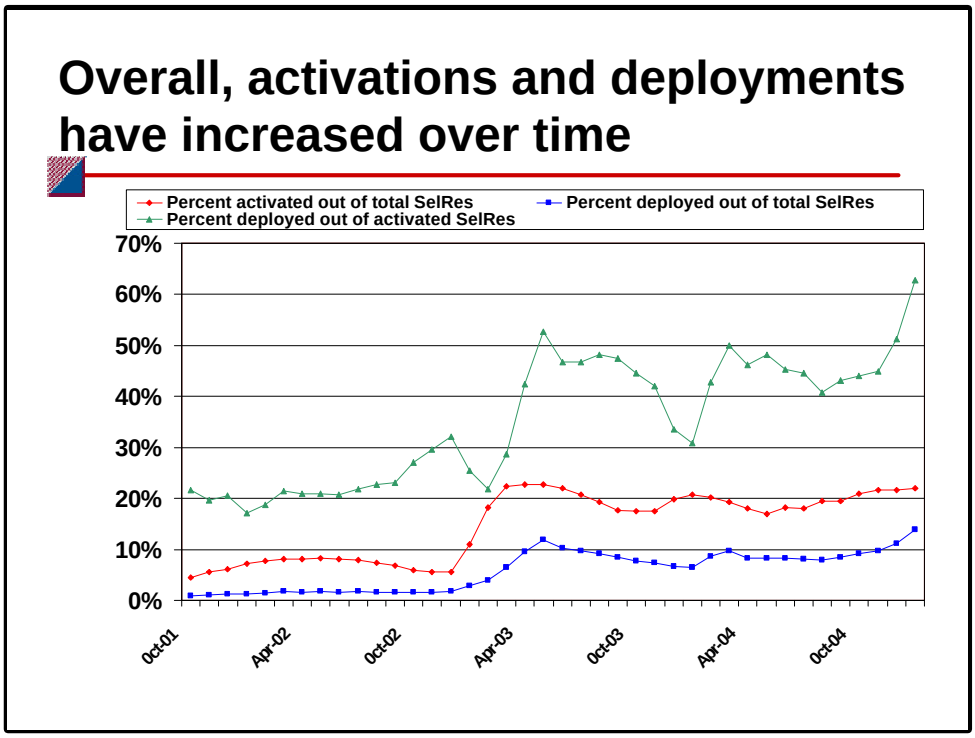
Among those enlisted members of the SelRes with a completed activation, about one out of two deployed in support of a contingency. Compared with other Reserve components, the USAR, ANG and the USMCR deployed the greatest proportion of their activated reservists, over 50 percent, while the ARNG deployed the greatest absolute number.

Over one-half of ongoing activations* were deployed in support of a contingency



*Note, we are referring to all ongoing active duty periods as of July 2004.

Among ongoing activations, the overall proportion deployed in support of a contingency had increased to over one-half in July 2004. About half of activated reservists from all six branches were deployed, while almost three-fifths of the activated AFR members were serving on active duty OCONUS. All but the ARNG deployed more than 50 percent of those activated. Because these are ongoing activations, however, the deployment status of members may change from not deployed to deployed as the active duty period continues over time.



In this slide, we show the history of activations and deployments of the enlisted SelRes. The red line indicates the percentage activated since October 2001 for all enlisted SelRes members. The blue line indicates the percentage of total enlisted SelRes members who have deployed. And the green line shows the percentage of those activated who have deployed overseas.

Each data series displays two distinct patterns before and after the beginning of OIF in the spring of 2003. The overall percentage levels of those activated and those deployed tended to be more consistent leading up to OIF, they increase somewhat dramatically around April 2003, and then establish a new level of consistency. For example, from October 2001 through December 2002, the overall percentage of enlisted SelRes members who were activated hovered between 5 and 8 percent. In January 2003, as U.S. forces began preparing for OIF, this percentage began a 3-month increase reaching just over 20 percent by March. Since that time, the percentage of enlisted SelRes members has remained between 17 and 22 percent. In contrast, the percentage of those activated who deployed has increased over time but has experienced more relative fluctuations over the course of the OIF contingency.

For those who are interested, we also provide the activation and deployment history percentages for each Reserve organization in appendix A. Next, we will turn our attention to a descriptive analysis of SelRes loss rates.

Calculating loss rates

- For each month, identify reservists at end of the month and look forward "x" months to see if still in SelRes
- Compute 6-month loss rates as weighted average across all months (Oct '01 – July '04)
- Note: 6-month updates to data will result in changes to all loss rates because
  - SelRes members are changing status from month to month
  - DMDC continues to improve the integrity of the contingency file

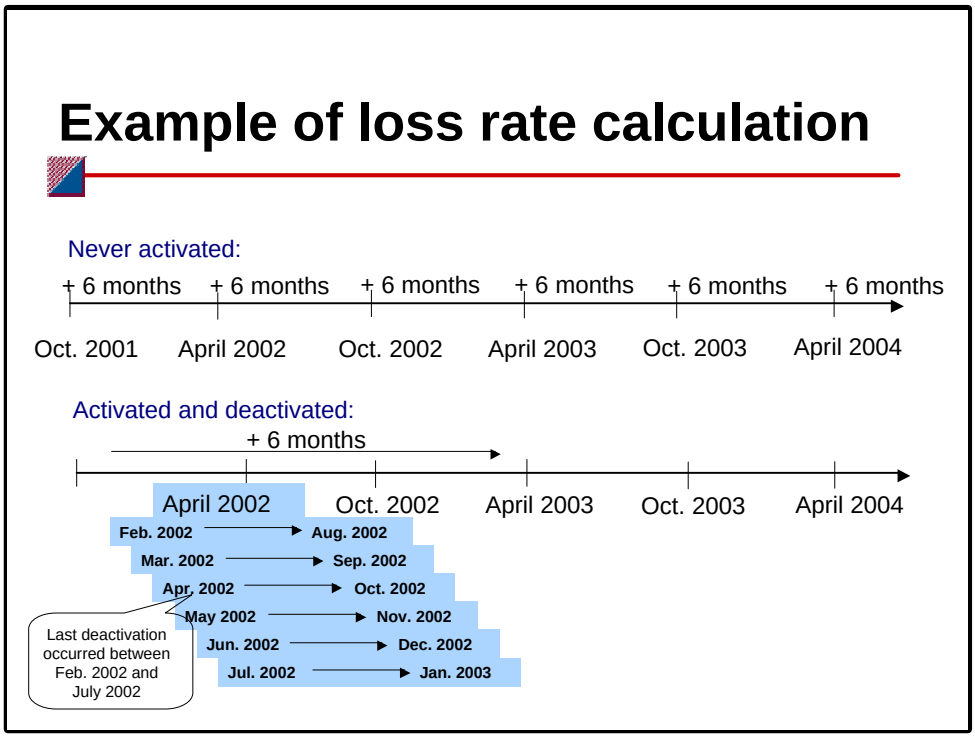
We calculate a 6-month loss rate for enlisted SelRes members who have recently been deactivated or never activated. SelRes members who are activated are under stop-loss orders and cannot leave the SelRes until they are deactivated. By definition, their loss rate is 0. We do not include SelRes members who are activated during an observed time period in the loss rate calculation for that period, because they are not eligible to leave and their inclusion will artificially lower the loss rate (see appendix B). For each month, we identify reservists in the SelRes at the end of the month and then look forward 6 months to see if they are still in the SelRes. We compute an overall 6-month loss rate that is a weighted average across the entire observation period (from October 2001 through July 2004). We also compute loss rates at various points in time so we can assess how loss rates are varying over the entire observation period.

Our plan is to update the loss rates every 6 months, which will add a new observation to our point-in-time calculations. For this final report, we updated our database with data through January 2005, added April 2004 to our point-in-time observations, and recalculated all loss rates. Previously, our data ran only through July 2004 and we determined 6-month loss rates for members who completed their activation period by January 2004.

In undertaking this update, we have found that the loss rates throughout the time period do not remain the same because SelRes members' activation status are constantly changing over time and because DMDC continues to improve

the integrity of the contingency file. We matched the records of reservists who had completed activations by January 2004 from our previous database to the updated database. We found that 367 reservists did not show up in the new file, but we had 7,988 new observations for reservists who were not on the contingency file previously who had completed their active duty periods by January 2004.

In practical terms, the dynamic nature of the Reserve mobilization means that each month Reserves potentially will be changing their status—for example, from never activated to activated or from recently deactivated to activated. We also know that DMDC continues to refine the contingency file *back through time* in addition to adding new information with each passing day. Tracking Reserve losses becomes an ever-moving result in need of a multivariate model that appropriately takes into account the dynamic nature of the mobilization, the time factor, and other important demographic variables. We will discuss the implications of these issues in more detail in the second half of this annotated briefing when we address the need to model of Reserve loss behavior.



As shown above, we look at six point-in-time snapshots for those SelRes members who are never activated and five time windows for those who are activated and deactivated. Remember, for the duration of the period from October 2001 through January 2005, we split SelRes members into two groups—the never activated and those with completed activations. Once a person is classified in one group, the classification does not change.

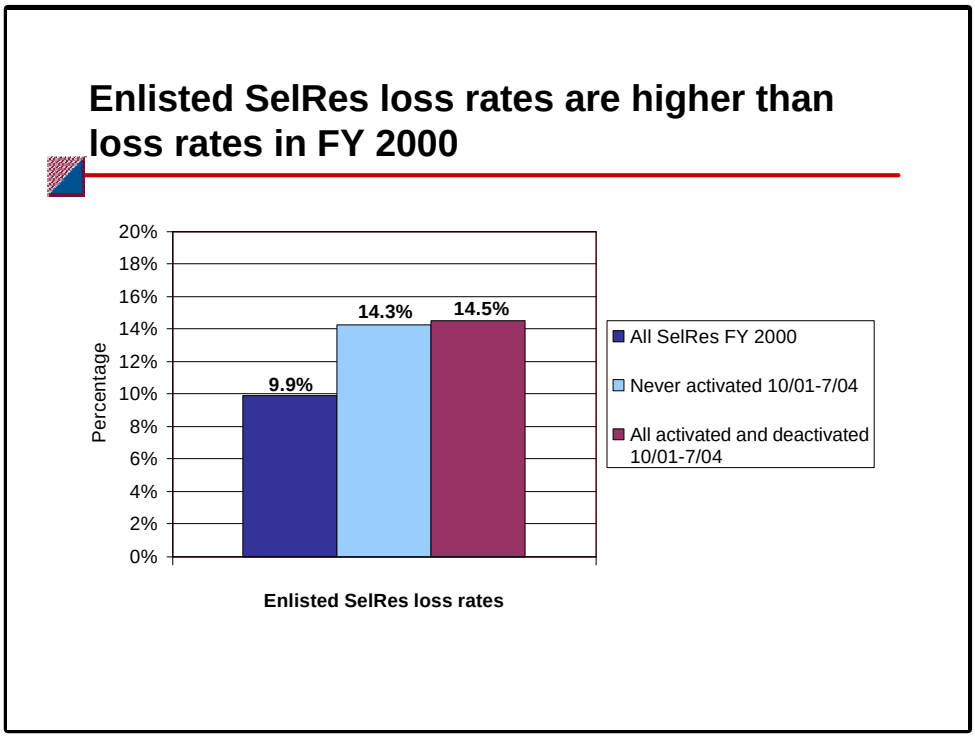
For the never-activated loss rate calculation, we calculate losses 6 months after each of the following six points in time: October 2001, April 2002, October 2002, April 2003, October 2003, and April 2004. The denominator is equal to the number of SelRes members who have never been activated and are in the SelRes at the end of each point in time. Thus, we include in the denominator SelRes members who stay for the next point-in-time loss rate.

We include SelRes members with completed activations in only one point-in-time loss rate calculation, which depends on the time window in which the member's deactivated month falls. An example will help to clarify. As shown in the display above, the April 2002 point-in-time 6-month loss rate includes in its denominator all SelRes members whose activation ended in February 2002 through July 2002. We then look 6 months out from the respective deactivation month to see if the SelRes member is still in the SelRes. In turn, the denominator for the October 2002 loss rate calculation includes all SelRes members whose deactivated date fell between August 2002 and January 2003, and so on.

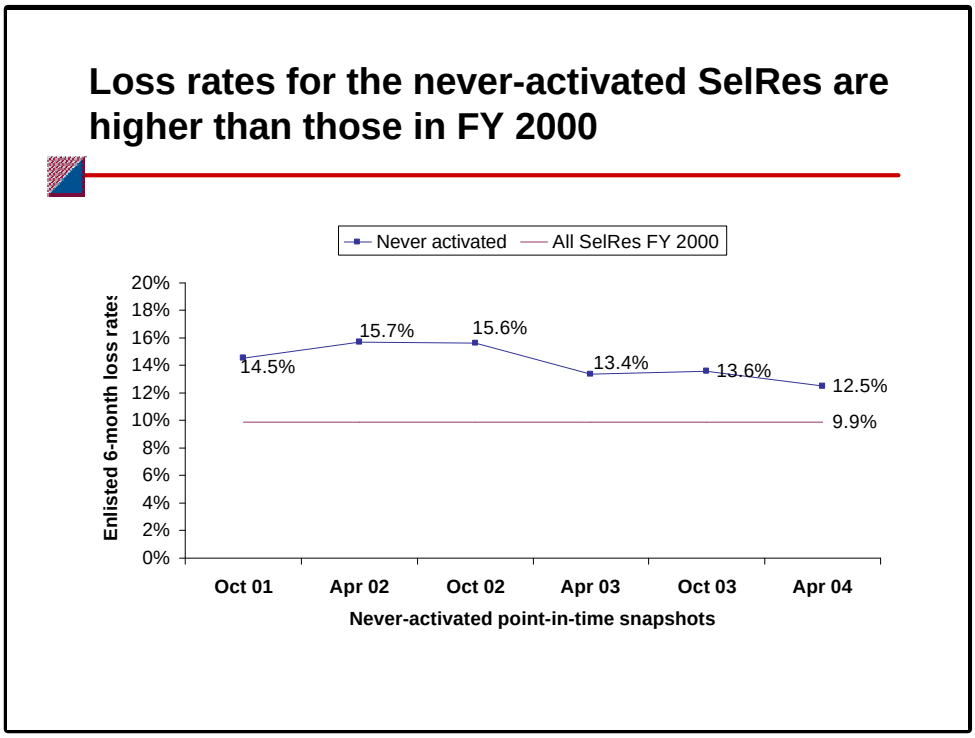
Loss rate patterns

- Activated vs. never activated
- By deployment status
- By length of active duty period
- Multiple activations

We examine loss rate patterns by activation status, deployment status, length of active duty period, and multiple activations. One might anticipate that loss rates would differ depending on whether the person volunteered or was involuntarily mobilized. Unfortunately, the data do not provide information on the nature of the activation. In addition, key informants from each service noted in interviews with us that, in order to lessen potential difficulties that a member might experience with his or her employer, the services generally write an involuntary activation order even if the SelRes member volunteered.



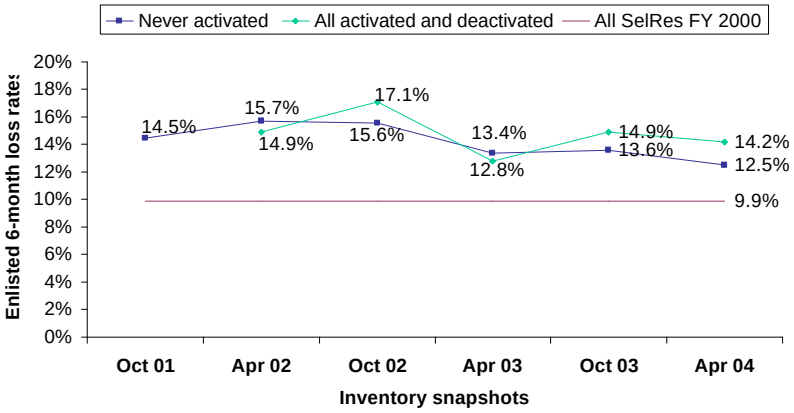
Overall 6-month loss rates for enlisted SelRes members since October 2001 are higher than loss rates in FY 2000 when the Reserves were not operating under a presidential mobilization order.



In this slide, we show point-in-time loss rates for all SelRes members who were never activated from October 2001 through January 2005 compared with the average loss rate for FY 2000 and the average loss rate for all activated and deactivated SelRes. First, the average loss rate for the recently deactivated is 4.6 percentage points higher than the loss rate in FY 2000 (14.5 percent versus 9.9 percent). This level of increase is consistent with the level of increase in loss rates observed after DS/DS [1].

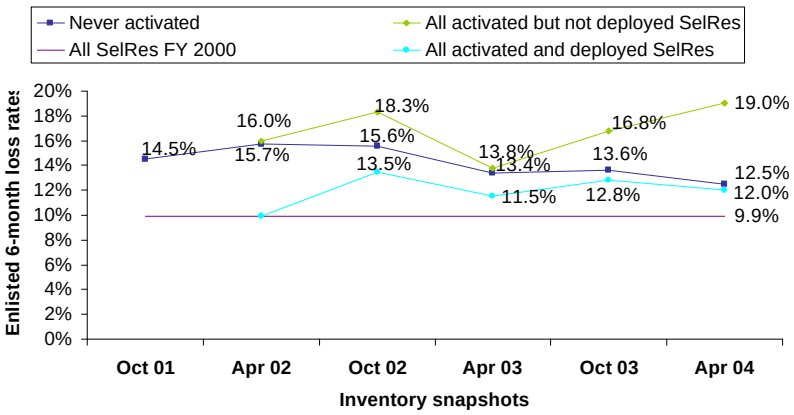
Second, loss rates for the never activated are consistently higher than the average loss rate in FY 2000. Over time, the loss rate for the never-activated SelRes increases slightly and then decreases to a slightly lower level. We believe that the slight increase in loss rates may reflect an initial reaction to the President's callup of the Reserves. This reaction appears to diminish over the observation period as anticipatory losses decrease.

Loss rates for the recently deactivated SelRes and the never-activated SelRes have tracked somewhat closely over time



In this slide, we have replaced the average loss rate for the recently deactivated over the entire observation period with point-in-time loss rates (as described in slide 10). Loss rates for the recently deactivated usually are as high as or slightly higher than the never-activated loss rates and are consistently higher than the average loss rate in FY 2000.

Loss rates are higher for the activated but not deployed compared with those who deployed *and* those who never activated

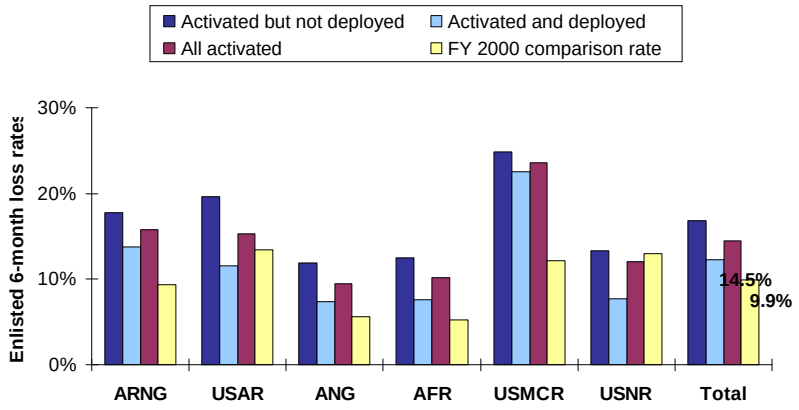


Next, we consider loss rates for the recently deactivated SelRes in terms of whether they were

- Activated but not deployed or
- Activated and deployed.

Loss rates are consistently higher for those who were activated but not deployed compared with loss rates for the (1) never activated and (2) those who were activated and deployed. Furthermore, loss rates for those who were activated but not deployed have increased during the past two observation periods following a nearly 5-percent decrease in April 2003. It may be that, if activated, reservists prefer to have a direct involvement in the contingency rather than a less direct role. It also may be that reservists' employers are more supportive of the activation if the person deploys than if he or she remains in CONUS. Keep in mind, however, that loss rates for all groups are higher than the average loss rate in FY 2000.

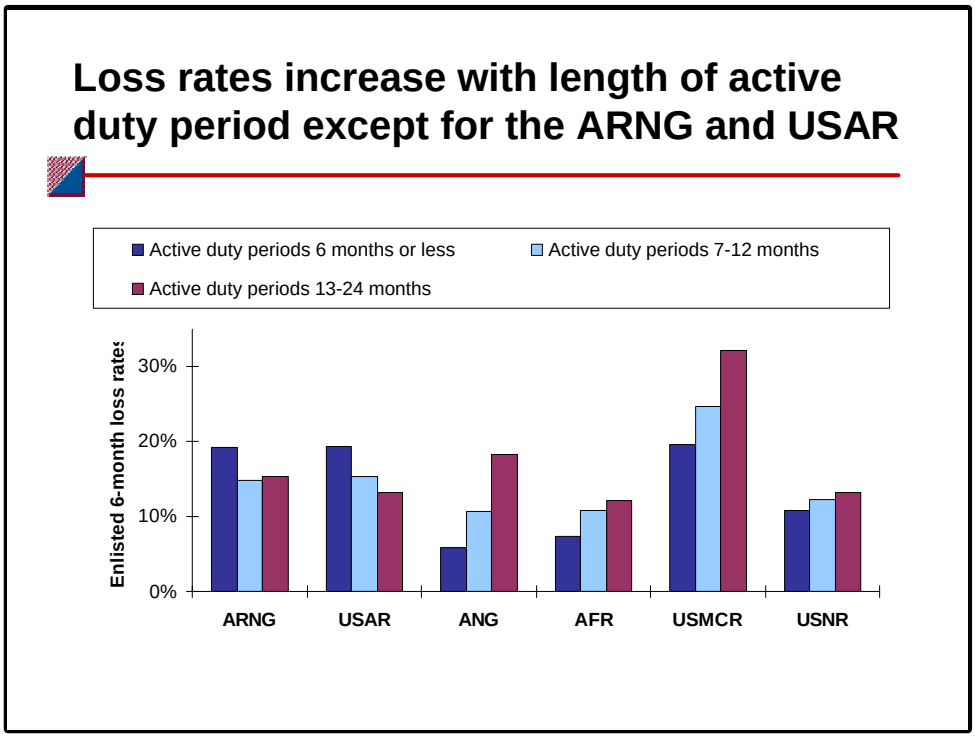
Across components, activated SelRes loss rates are higher than in FY 2000; deployers have lower loss rates than those who stay in CONUS



The pattern of higher overall loss rates holds when we examine average loss rates for the recently deactivated by deployment status for each Reserve component. With the exception of the USNR, loss rates for the activated SelRes are higher than loss rates in FY 2000. If we compare the red bar (all activated) and the yellow bar (FY 2000 baseline), the level of percentage increase in loss rates is most striking for the

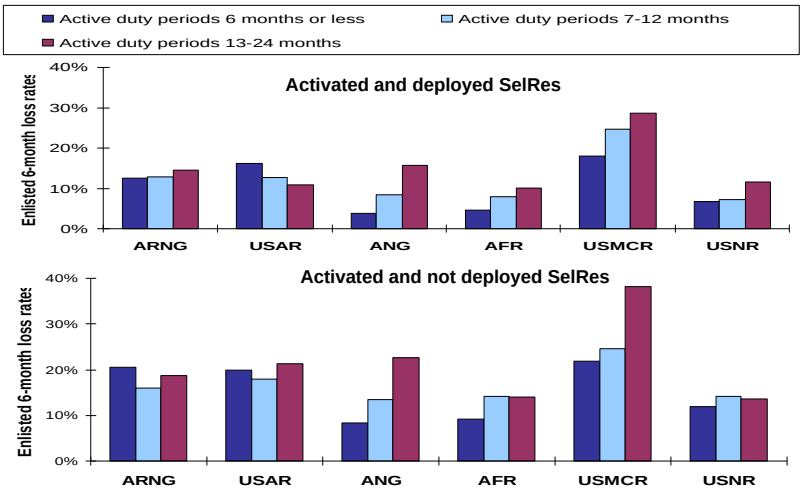
- ARNG (70 percent higher),
- ANG (68 percent higher),
- AFR (91 percent higher), and
- USMCR (95 percent higher).

In addition, those who deploy have lower loss rates than those who are activated and remain in CONUS. (In appendix C, we also provide point-in-time loss rates for each Reserve component.)

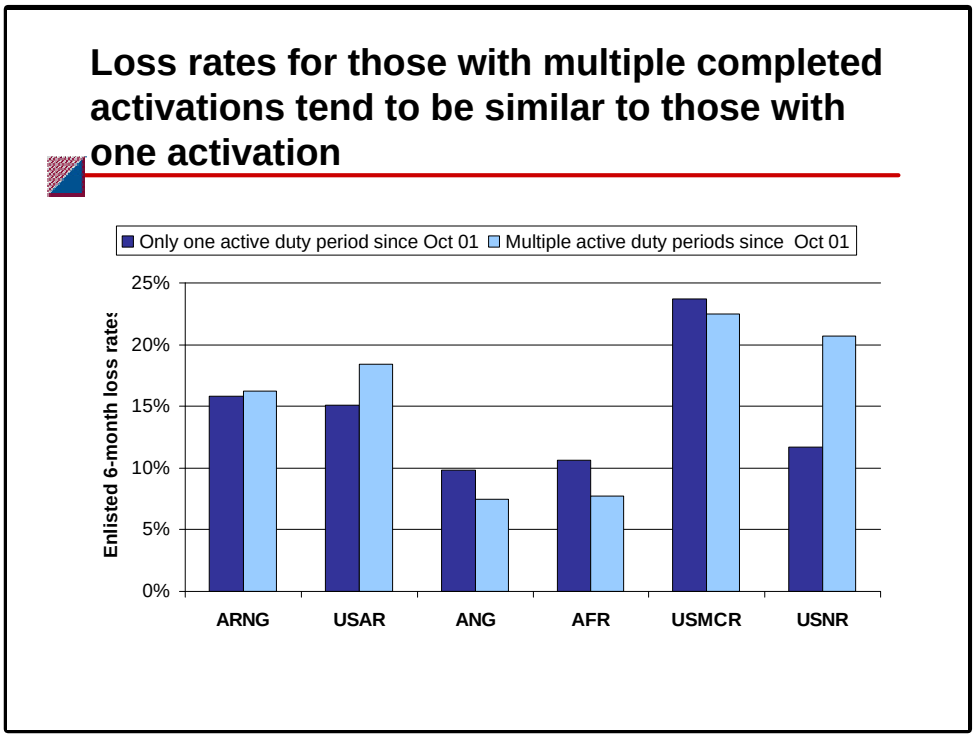


Earlier we saw that the length of completed activations in the ARNG and the USAR tended to be for 7-12 months or 13-24 months. In contrast, completed activation periods for the ANG, the AFR, the USMCR, and the USNR have tended to be for 6 months or less or for 7-12 months. Is the length of the active duty period related to whether a SelRes member stays or leaves? It appears to be related but in different ways for different Reserve components. On one hand, for the ARNG and the USAR, loss rates decrease as the length of the activation increases. On the other hand, loss rates appear to increase with the length of the active duty period for enlisted members in the ANG, the AFR, the USMCR, and the USNR.

In general, the stair-step patterns continue to hold, except for the ARNG and USAR



Above we show loss rates for the recently deactivated by length of active duty period broken out by deployment status. For the most part, the increasing stair-step pattern holds for the ANG, AFR, USMCR, and USNR regardless of deployment status. The decreasing pattern for the ARNG and USAR is less distinct when we examine loss rates by length of activation by deployment status. Overall, loss rates are consistently higher for those activated and not deployed. The increase in loss rate as the active duty period lengthens is particularly distinct for members of the ANG and USMCR who were activated and not deployed. These patterns suggest a preference among reservists for shorter activation periods that include deploying rather than staying in CONUS.



Among those members of the SelRes who have been activated since 9/11, many have served more than one active duty period. Here we compare loss rates for those with multiple completed activations with loss rates for those with one activation, and we find that these loss rates are fairly similar in general. While the similarity between loss rates for these groups may at first seem counter-intuitive, several factors may be at play here.

Keep in mind that DoD policy to this point in the Reserve callup is to limit the number of months that a SelRes member can involuntarily serve under this mobilization to 24 *cumulative* months even though the law specifies a limit of no more than 24 *consecutive* months. This means that SelRes members who have more than one completed activation were most likely on active duty for shorter periods of time. We know from our analysis so far that loss rates for the recently deactivated tend to be lower for the shorter activation periods. Also, SelRes members may be more likely to leave after the completion of their first active duty period if they are disillusioned with the system. A decision to stay in the SelRes after the first completed active duty period may indicate a willingness to serve again, which in turn would dampen loss rates following deactivation from a second or third tour. Finally, SelRes members with multiple completed activations may be disproportionately volunteering for additional duty, a distinction (discussed earlier) that we are not able to discern in the data.

Summary of issues

- Major findings:
  - Overall magnitude of increase in loss rates is not so bad but requires continued monitoring
  - Deployment status and length of activation appear to matter to reservists
- Next steps?
  - Need to account for the dynamic, multifaceted nature of Reserve loss behavior
  - Requires more sophisticated modeling approach

Our analysis suggests that overall the magnitude of increase in loss rates is not as bad as anecdotal evidence reported by the popular press has suggested. There are some indications, though, of potential growing problem areas, specifically with respect to loss rates for enlisted SelRes members who have been activated but not deployed. Under the National Defense Authorization Act of 2004, Congress has provided DoD with tools (e.g., accession and retention bonuses) that may prove helpful. However, the issue of Reserve loss behavior demands continued attention at least through the duration of the mobilization and perhaps for some time after.

Our research to date highlights a number of patterns that are directly related to Reserve force management. First, if we are going to activate reservists, it is better (from the attrition standpoint) to deploy them. Second, multiple activations are not necessarily bad; however, it is clear that the duration of the active duty period matters. Shorter is better. It may be that predictability matters with respect to the frequency of activation and the duration. Expectations for reservists need to be clear.

The challenge will be figuring out exactly what Reserve force management strategies and policies should be and how to achieve them. The descriptively focused work that we have conducted to date is an important first step to understanding the factors that affect Reserve losses. However, a more sophisticated modeling approach should provide a fuller picture of the dynamic, multifaceted nature of Reserve loss behavior. In the remainder of this annotated briefing, we consider potential ways to approach modeling Reserve losses.

Comparing loss rates

- Want to compare the 6-month loss rates of SelRes members who are newly deactivated with the loss rates of….which group from the SelRes?

Up to this point, we have taken an important first look at how activation might be affecting SelRes loss behavior. Using descriptive techniques, we compared 6-month post-deactivation loss rates with the 6-month loss rates of never-activated SelRes members, calculated at particular points in the observation period.[5]

To set the most effective and efficient Reserve personnel policies, however, policy-makers need to have a thorough understanding of SelRes loss behavior. This includes having the most accurate measurement possible of the effect of events, such as activation and deployment, as well as other observable characteristics, such as occupation and length of service, on the probability of leaving the SelRes.

Because effective policy-making depends on it, it also is important to understand the limitations of the loss rates that we have presented and suggest ways to overcome those limitations. In particular, we need to understand how our simple loss rate comparison is affected by the definition of the "never-activated" (i.e., reference) group in our sample. By almost any definition of

[5] Recall why we define "loss" as exit from the SelRes in the 6 months following deactivation. If we limit our look at loss behavior to less than 6 months after deactivation, we risk limiting our calculation to a period of time when some SelRes members may not have been legally able to leave the SelRes, such as the 90-day period immediately following deactivation. If we include loss behavior that is more than 6 months beyond deactivation, we increase the chances that experiences that take place after deactivation are influencing the decision to leave or stay.

the reference group, we can introduce sample selection bias in our calculations. That is, depending on how we define our never-activated sample, we risk calculating a loss rate that improperly weighs the loss behavior of some never-activated SelRes members more heavily than the loss behavior of other never-activated SelRes members.

For example, to make the loss rate comparisons shown in the earlier parts of this brief, we defined a never-activated sample of SelRes members who met two criteria. First, these SelRes members had to be in the September 2001 inventory or had to enter the SelRes at some point from October 2001 to July 2004. Second, these SelRes members could never be activated during the entire October 2001 to January 2005 period.

When we calculated the 6-month loss rates for the never-activated SelRes members in October 2001, the calculation included members in the inventory in September 2001, including

- Those who left in the 6 months following October 2001
- Those who stayed for 6 months following October 2001 but left before January 2005
- Those who stayed for the entire observation period.

But when we calculated the 6-month loss rate for the never-activated SelRes members in April 2004, the calculation included

- Those in the inventory in September 2001 who stayed until at least April 2004 (e.g., the never-activated inventory no longer included those who left the SelRes before April 2004)
- New (and never-activated) SelRes members since October 2001 who stayed until at least April 2004.

Never-activated members who stayed in the SelRes for the entire observation period clearly display different loss behavior than never-activated members who left before the end of the observation period. Thus, the never-activated loss rate may be biased over time by the ever-increasing presence of the long-term "stayer" group in the sample. Virtually all other definitions of "never-activated" can create a selection bias as well.

Expanding to a model of loss behavior

A model of loss behavior should:

- Account for movements of all SelRes members from nonactivation to activation and to loss over the entire observation period
- Account for the effect of activation length on loss
- Include information on those who have not completed their activation period
- Account for other differences among SelRes members that may affect their loss behavior
- Include all types of losses due to activation, including losses due to perceived possibility of activation
- Be computationally feasible

To avoid issues of selection bias and to more precisely quantify the effect of activation on loss behavior, we need an explicit model of the probability of leaving the SelRes. Ideally, this model would have several key features.

The model should eliminate the need to define a reference group whose non-activation status spans the entire observation period. One way to do this is to recognize that SelRes members move from not activated status, to activated, or to loss at different points in the observation period. The goal is to model the probability of moving (or transitioning) from one status to another. Of particular interest is whether the probability of leaving the SelRes is different for those who were previously in activated status than for those who were not. In addition, an ideal model would capture not only the effect of *any* activation on the probability of leaving the SelRes, but also the effect of the *length* of activation on loss behavior.

A successful model would also incorporate as much information as possible about SelRes members who are either still activated at the end of the observation period or for whom we could not observe a full 6 months beyond deactivation. Our simple loss rate comparison does not allow for using data on these SelRes members, yet we show earlier in our discussion that these SelRes members are numerous.

Activation and deployment are events to which SelRes losses may be linked since they can cause major disruption in the home and work lives of SelRes members. To measure the effect of activation and deployment on loss

behavior as accurately as possible, however, we also need to account for factors in the SelRes population other than activation experience that might affect their propensity to leave, such as length of service and occupation in the military.

Another important modeling consideration is that the *possibility* of being activated may affect loss behavior. An ideal model would incorporate the effects of increased activation activity on the loss behavior of the entire SelRes, not just for SelRes members who actually had been activated.

Finally, we must be able to estimate this ideal model. Although there are models that have all of the features listed above, they can be computationally very difficult to estimate. A truly comprehensive theoretical model is critical for our understanding of loss behavior, but we need to consider the tradeoff between theoretical precision and quantifiable results.

Fuller treatment of SelRes activity

- "States" in a model of SelRes activity are:
  - In SelRes but not activated
  - In SelRes and activated
  - Not in SelRes (e.g., loss)

Our earlier loss calculations suggest that there are two distinct groups of SelRes members. Yet, the data clearly show that SelRes members move between nonactivation, activation, and loss throughout the observation period. Instead, we can think of these conditions—not activated, activated, or loss—as representing different states of SelRes activity.

To model movement between these states, we can break the observation period into discrete subperiods. Every SelRes member from the original September 2001 inventory begins the first subperiod (October 2001) in either the activated or nonactivated state. Conditional on the state in which the SelRes member begins the subperiod, we can calculate the probability that the SelRes member stayed in the same state, moved to another state, or left the SelRes by the beginning of the next subperiod. As new members enter the SelRes, we can incorporate their subsequent period-by-period stay/leave behavior as well.[6]

This method allows us to estimate all sequences of one-period transition probabilities that span the entire observation period. Every sequence represents a different pattern of one-period transitions between nonactivation, activation, and loss. For example, we can calculate the sequence of one-period transition probabilities to estimate the behavior of SelRes members who remain in the nonactivated state for the entire observation period. Another sequence estimates the behavior of SelRes members who stay in the non-activated state for only half of the observation period and then leave the SelRes. Yet another sequence estimates the behavior of SelRes members who are activated, deactivated, and leave the SelRes before the end of the observation period, and so on.

[6] Readers might recognize this as a one-period Markov chain model. The length of a subperiod could be 1 month or longer. Practically speaking, 6-month-long subperiods may make the most viable model.

Possible combinations of states over time

Initial period	Second period	Third period
Not active	Not active	Not active
Not active	→	Loss
Not active	→	Active
Not active	Active	Not active
Not active	Active	Loss

Although, in principle, there are many different paths that a SelRes member might take with respect to activation and loss over the observation period, we found that SelRes members follow five general patterns. We illustrate each here.

There are two paths that SelRes members who were never activated take over the current observation period (October 2001 to January 2005). One sizable group of these SelRes members stayed in the SelRes for the entire observation period. The other group left before the end of the observation period.

SelRes members who became activated sometime in the observation period can take one of three paths. One group was activated and remained activated through the end of the observation period, so that we could not observe the members' post-deactivation loss behavior. Another group was activated and then deactivated, and we were able to observe its members long enough to know that they do not leave the SelRes in the 6 months following deactivation. The last group was activated and deactivated, but its members left the SelRes during the 6 months following deactivation.

Modeling the probability of loss

- Want to model:
  - The probability of a transition from one state to another, controlling for various explanatory variables, such as occupation and age
  - The time in each state, controlling for various explanatory variables

A "state" model allows us to estimate two important dimensions of the effect of activation on the probability of loss. First, we can estimate the probability of moving from one state to another. As we have already described, we are interested in whether the probability of leaving the SelRes (i.e., transitioning to the loss state) depends on the state from which the member is moving. Since the probability of transitioning to another state may also depend on other characteristics of the SelRes member, we need to control for the member's length of military service, age, race/ethnicity, gender, marital and dependent status, and occupation in the military.

Our earlier slides suggest that longer activation periods appear to raise the post-deactivation loss rate.[7] However, the one-period-ahead transition probabilities don't fully capture the effect of length of activation on post-deactivation loss behavior. We can adapt the state model to estimate the time spent in each state. A key question is, "Does the probability of leaving the SelRes post-deactivation change as the activation period lengthens?" Again, we must control for the member's demographic profile in our estimation of time spent in each state.

[7] As a reminder, in our earlier slides, we did not control for other (demographic) factors that could affect loss behavior. It may be that some of these factors are more prevalent in the sample of SelRes members with long activation periods than in the sample with short activation periods.

Some specific assumptions needed to estimate the model

- Model the probability of making a transition from one state to another using a multinomial logit
- Given a specific state (e.g., in SelRes but not activated), model the time spent in that state by a Cox regression model
  - Handles truncated spell data well
- Combined, these two create a model that is a special case of a semi-Markov model (process)

By making some fairly standard assumptions, we can estimate the probability of moving from one state to another, conditional on starting in a particular state, using a multinomial logit regression approach. Likewise, we can use the Cox regression technique for estimating the time spent in a particular state.

The multinomial logit and the Cox regression techniques can account for factors in the SelRes population other than activation experience that might affect their propensity to change states or to lengthen time spent in a state, respectively. In addition, the Cox regression model can include cases where SelRes members are either still activated at the end of the observation period or for whom we could not observe a full 6 months after deactivation.

A model that combines the probability of changing states with the length of time spent in a state was successfully estimated using a combined logit/Cox regression approach in [2]. These authors developed a model of the advancement of enlisted Sailors and estimated both the probability of transition from a particular paygrade (allowing for promotions, demotions, and losses) and the time spent in a paygrade before a transition. Our research questions concerning SelRes losses have a number of similarities to the model presented in [2].

Other concerns

- How can we incorporate "perceived" activation or "reactivation"?
  - Can we impute this probability for each person in our sample?
- Can we consider multiple spells of activation using our data?
- Other classes of models?

So far, the modeling strategy we have presented does not explicitly measure how the possibility of being activated might alter SelRes loss behavior. We need to consider this behavior because losses that are due to avoiding activation can be as much of a problem for the SelRes as post-deactivation losses are. Indeed, our research suggests evidence of this type of loss behavior. Both the never-activated loss rates and the 6-month post-deactivation loss rates calculated during a period of relatively high activation activity (October 2001 to July 2004) exceeded the FY 2000 baseline SelRes loss rates (e.g., loss rates calculated during a period of relatively low activation activity).

One way to incorporate this behavior is to estimate the probability of being activated in the early part of our observation period, controlling for differences in demographic profiles. An estimate of the probability of being activated could be derived for every SelRes member in our sample in that time frame. If we assume that the *perceived* probability of being activated is properly measured by the *estimated* probability of being activated, we could use that estimate to help determine the probability of leaving the SelRes in subsequent periods.

More generally, there is the possibility of utilizing a relatively new but growing literature on "neighborhood effects" to model SelRes loss behavior. A "neighborhood effects" approach attempts to model how people's behavior is affected by those who are similarly situated—that is, by geographic location, household composition, income class, race/ethnicity, or other demographic criteria.

For example, there are studies that determine how a person's choice of housing location, school, or whether to use drugs is affected by others in geographic proximity and/or similar economic circumstances. We can imagine a model of SelRes loss behavior that incorporates how the perception and actions of some members of a particular unit or military occupation concerning activation may influence the perceptions and actions of other members of the same unit or occupation.

There are other classes of models that could address the issues raised by measuring the effect of activation on the probability of leaving the SelRes. The authors of [3], for example, present a theoretical model of the reenlistment decision for active duty service members. The authors begin with the concept that a member derives utility from the experience of being deployed. The amount of utility is not known initially but is revealed over time as the member learns from deployment experiences. A member updates his/her expected utility based on this deployment learning process and on his/her expectations about future deployment. Ultimately, the member will reenlist if his/her expected utility is sufficiently high.

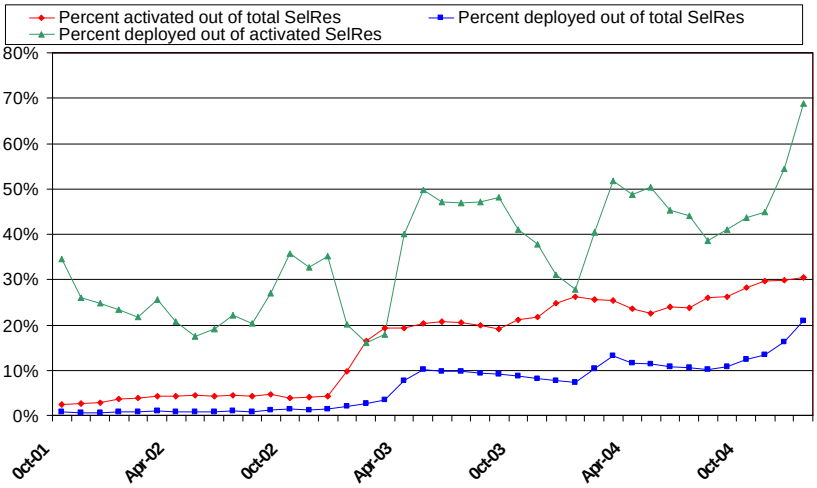
We can see similarities in this model of active duty deployment/reenlistment and the relationship of activation and loss in the SelRes population. However, while the expected utility approach may be theoretically comprehensive, it is computationally very difficult to estimate.[8] Instead, we are inclined to use the special case of the semi-Markov model because it provides a computationally feasible approach that we can use to model loss behavior .

[8] Although the authors of [2] lay out a comprehensive theoretical expected utility model, they estimate a probit model of reenlistment behavior.

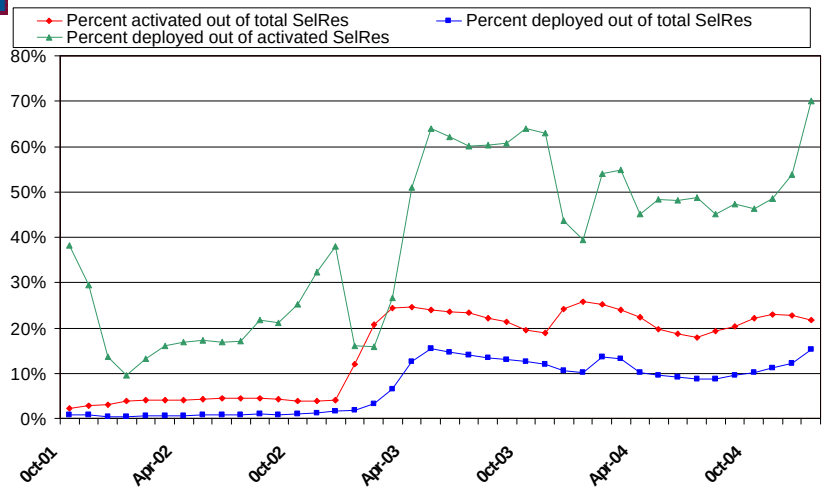
Appendix A

Activation and Deployment Histories for Each Reserve Organization

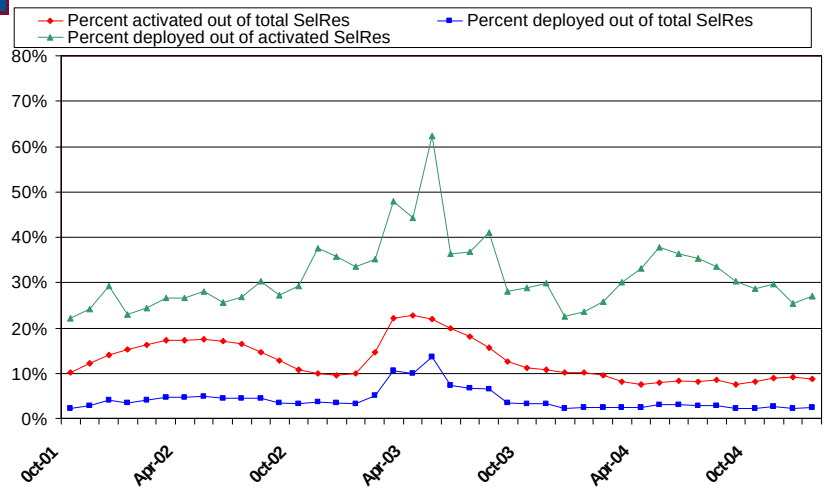
ARNG activation and deployment rates



USAR activation and deployment rates



ANG activation and deployment rates



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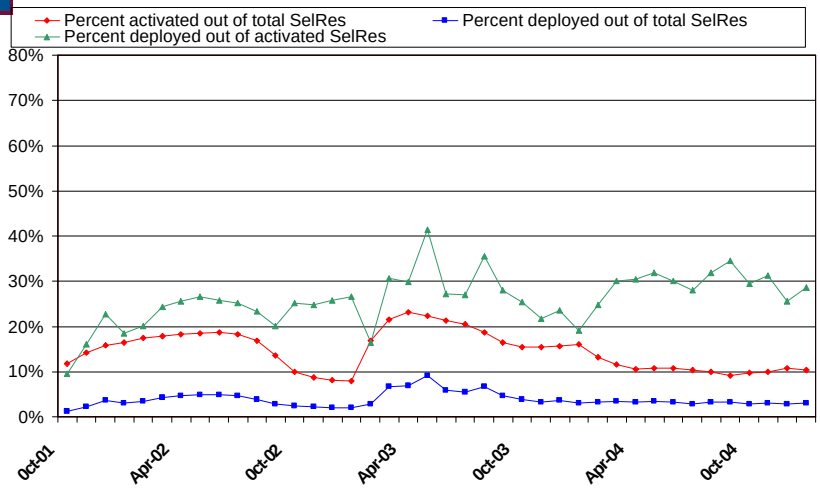
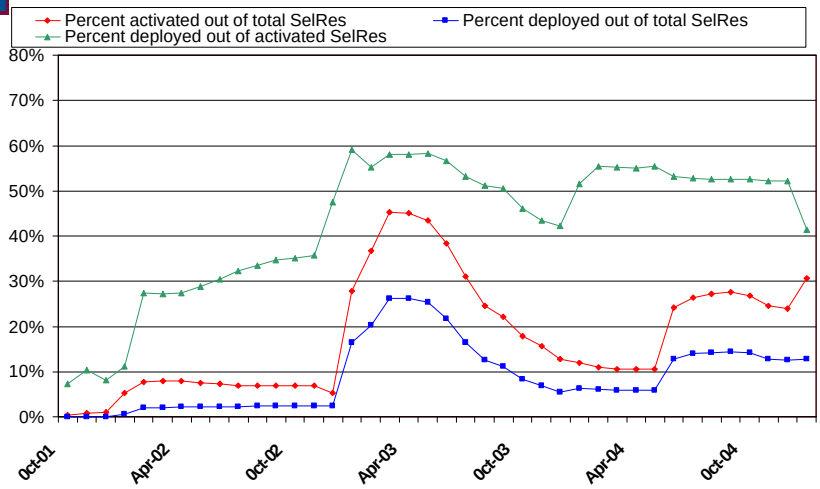
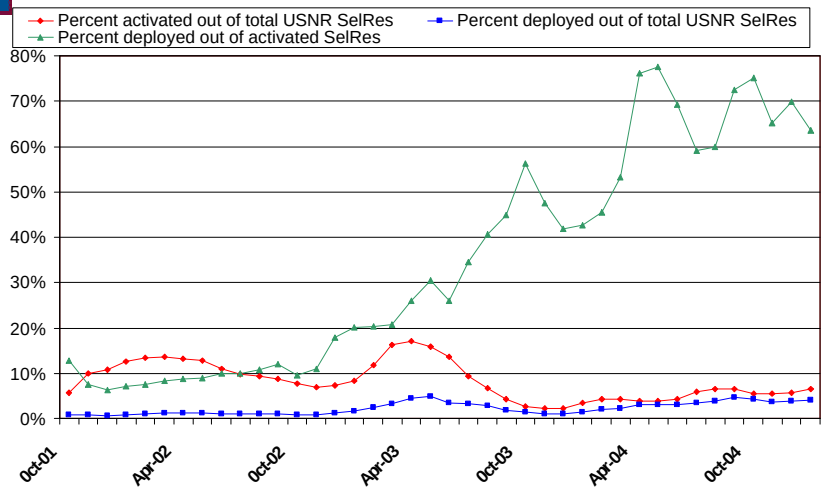


USMCR activation and deployment rates



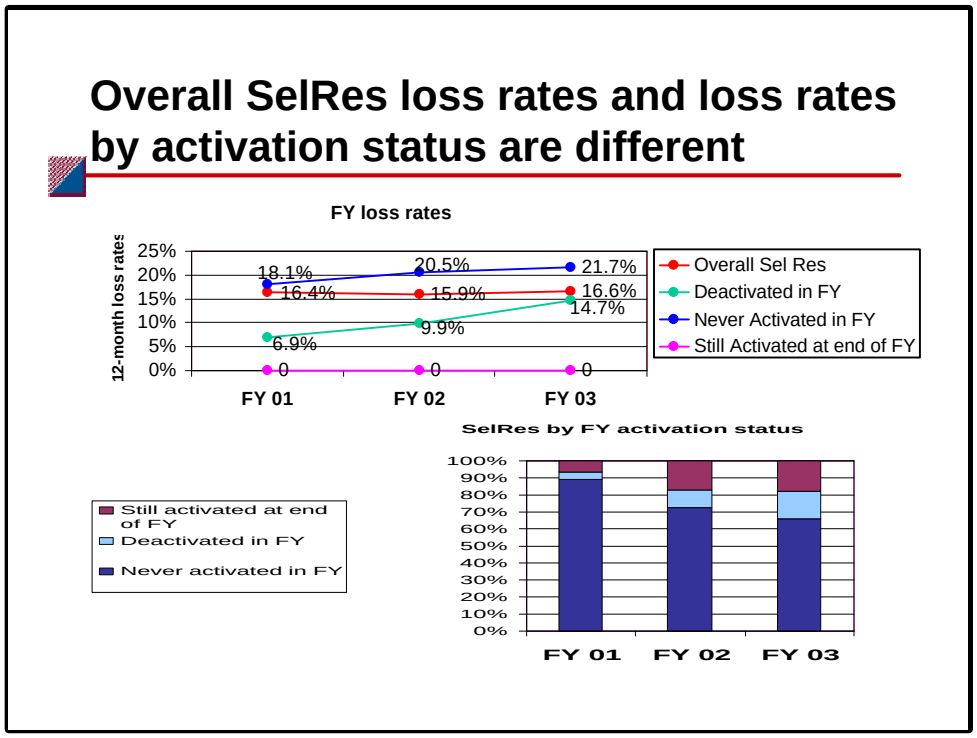
USNR activation and deployment rates



Appendix B

Challenges Associated with Computing SelRes Loss Rates during an On-going Mobilization

Other studies of post-9/11 SelRes loss behavior examined overall SelRes losses from one fiscal year to the next, without regard for activation (see [4], for example). The authors of these studies were not able to control for the effect of activation and deployment on loss behavior because such data were not available. One limitation of this method is that during a period of increased activation activity, a larger percentage of the SelRes is unable to leave at any given time. These "zero-loss-rate" SelRes members may offset increasing loss rates for SelRes members who can leave, so that the overall SelRes loss rate remains nearly constant. In the next slide, we look at how the activation status can affect fiscal year overall SelRes loss rates.

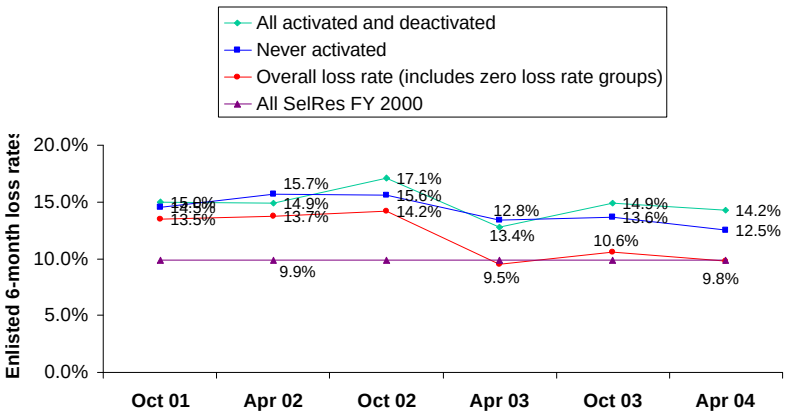


This slide illustrates how the fiscal year overall SelRes loss rate pattern can differ substantially from the loss rate pattern of certain SelRes sub-groups. Here we categorize SelRes members each fiscal year as not activated in that fiscal year, deactivated in that fiscal year, or still activated at the end of that fiscal year. Note that these are loss rates across the entire 12 months of a fiscal year, while we have used 6-month loss rates in all our analysis up to this point.

The upper graph shows that the post-9/11overall SelRes fiscal year loss rate remained relatively constant at about 16 percent from FY 2001-03. However, the fiscal year loss rates for the two sub-groups of the SelRes who were legally able to leave the SelRes----that is, members who were not activated in that fiscal year and members who were deactivated in that fiscal year---increased over the FY 2001-03 period. The fiscal year loss rate for members who were not activated in that year rose from 18.1 percent in FY 2001 to 21.7 percent in FY 2003. The FY 2001 loss rate for those who were deactivated in that fiscal year was 6 percent, but it increased to 15 percent by FY 2003.

SelRes members who were still activated at the end of the fiscal year are the remaining group who contribute to the overall SelRes loss rate. Their loss rate is zero. From FY 2001-03, there was a substantial increase in the number of activations, and therefore in the percentage of SelRes members who were still activated at the end of the fiscal year. The lower graph (bar chart) shows the proportion of SelRes members in each fiscal year that made up each of the three sub-groups. As the bar chart shows, the percent of the SelRes that was still activated at the end of FY 2001 was about 6.5 percent, but by FY 2003, that figure had increased to 18 percent. The contribution to the overall SelRes loss rate from these still-activated members (that is, the zero loss rate group) offset the increasing loss rates of the other two groups over the FY 2001-03 period.

Including the "zero loss rate" groups lowers the overall Sel Res loss rate

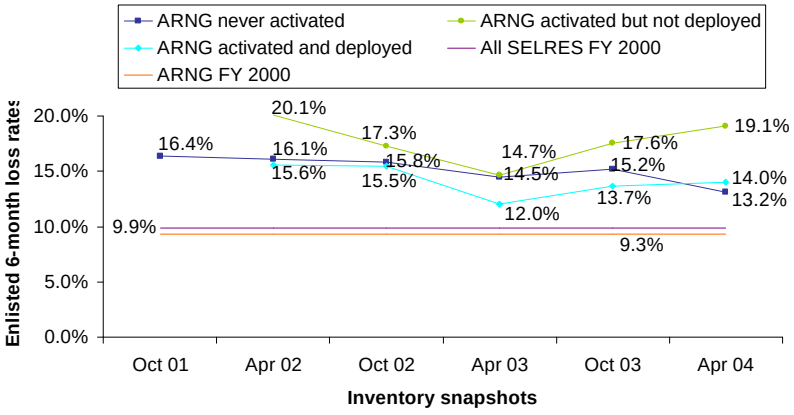


In this study, we compare the loss rates of recently deactivated SelRes members to the loss rates of two SelRes groups: a pre-9/11 group and a post-9/11 group. We chose the FY 2000 SelRes as our pre-9/11 loss rate comparison group because this was a year of relatively low activation numbers of activations. For the post-9/11 loss rate comparison group, we wanted to include SelRes members who were not activated at all in our observation period. In other words, we chose a very comprehensive definition of "never-activated" in that these SelRes members were never activated from 9/11 until January 2005. The result is that when we calculate loss rates at a point in our observation period, we leave out several SelRes groups who have zero loss rates---the SelRes members who are still activated at that point, the group of SelRes members who have been deactivated for more than 6 months at that point, and the SelRes members who will be activated some time from that point to January 2005. Because we have excluded various SelRes groups that have zero loss rates, our analysis approaches a "worst case" scenario of how SelRes loss rates changed after 9/11. But by doing so, we analyze two groups (the not-yet deployed and the recently deactivated) who are most likely to be leading indicators of an emerging negative trend in loss rates.

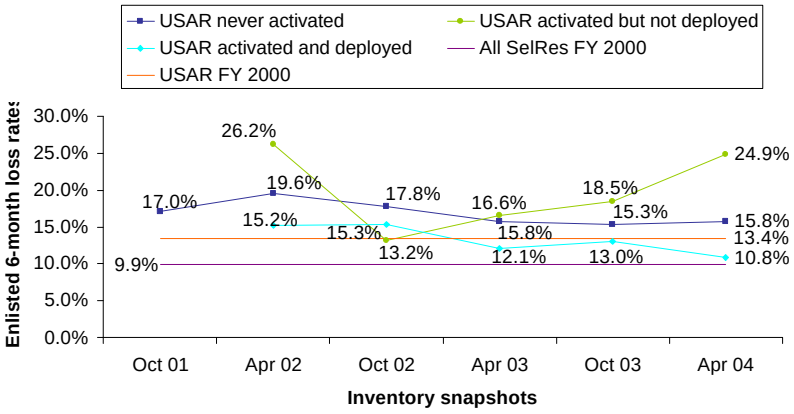
Appendix C

Loss Rate Inventory Snapshots for Each Reserve Organization

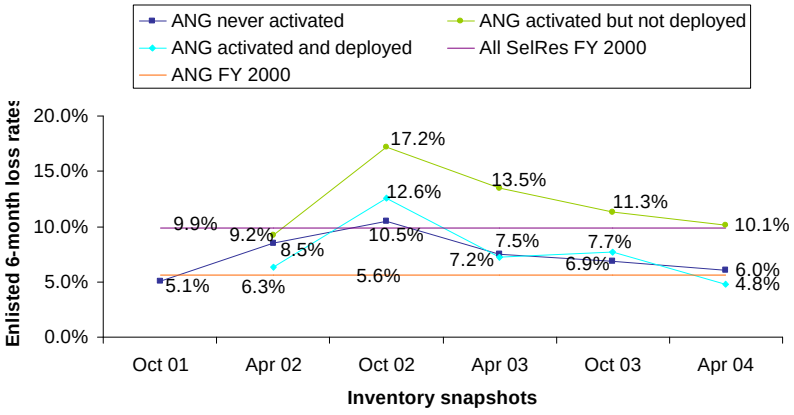
ARNG loss rates



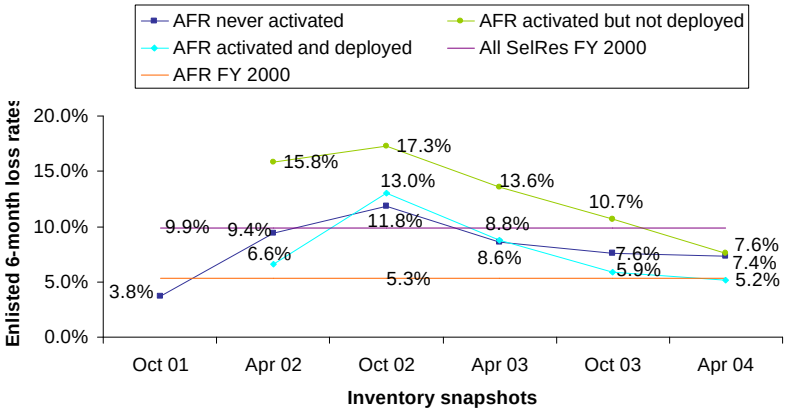
USAR loss rates



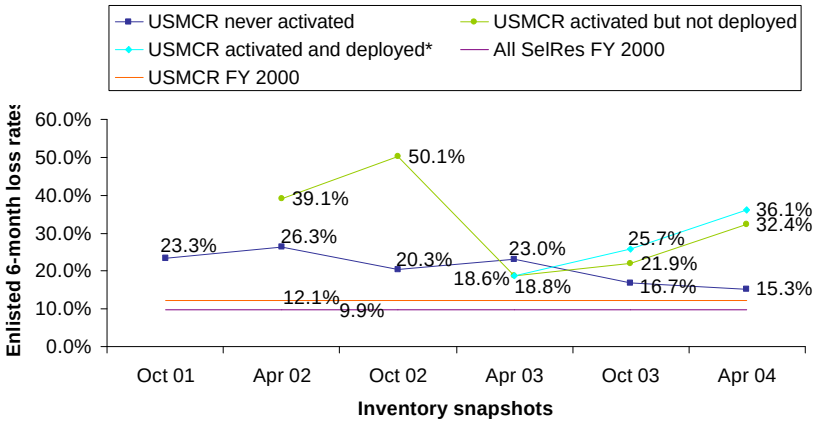
ANG loss rates



AFR loss rates

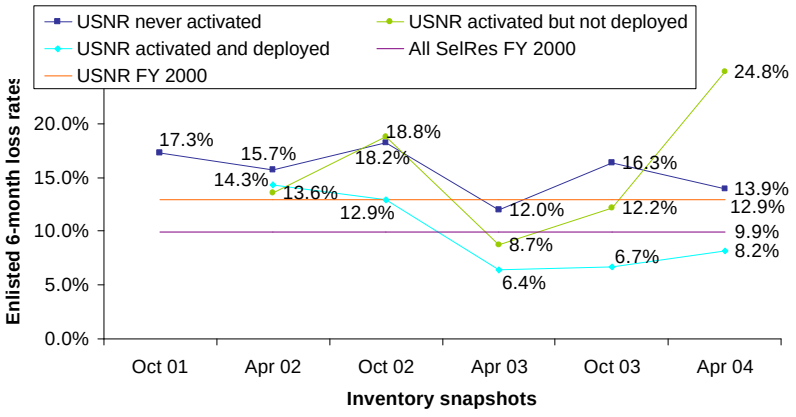


USMCR loss rates



Note: The numbers of Marines who were deployed and deactivated for the time periods of April and Oct 2002 were very small. For Apr 2002, there were only 4 Marines: 2 stayed, 2 left. For Oct 2002, there were only 15 Marines: 4 stayed; 11 left.

USNR loss rates



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[2] Philip Lurie, Robert Trost, and Edward Berger. *A Method for Analyzing Multiple Spell Duration Data*, Feb 1982 (CNA Professional Paper 340)

[3] James R. Hosek and Mark Totten. *Serving Away From Home: How Deployments Influence Reenlistment*, 2002 (RAND Publication MR-1594-OSD)

[4] Michael L. Hansen and Ian D. MacLeod with David Gregory. *Retention in the Reserve and Guard Components*, Apr 2004 (CNA Research Memorandum D0009534.A4)

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[1] Sheila Nataraj Kirby and Scott Naftel. *The Effect of Mobilization on Retention of Enlisted Reservists After Operation Desert Shield/Storm*, 1998 (RAND Publication MR-943-OSD)

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