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THE REENGINEERED 2010 CENSUS

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ABSTRACT

The reengineered 2010 Census consists of three highly integrated activities designed to dramatically improve upon what was a very good census in 2000. We will accomplish this by taking advantage of opportunities for innovation B made possible through the expanded use of technology B in order to: 1) increase the coverage, accuracy, and quality of census data; 2) reduce operational risk; 3) increase the relevance and timeliness of census long form data; and 4) contain costs. The three highly integrated activities we have embarked upon to meet these goals are: 1) the American Community Survey (ACS); 2) the MAF/TIGER Enhancements Program; and 3) a program of early and comprehensive planning, development, and testing for a short form only 2010 Census. We expect that the cost reductions in the last component will be sufficient to offset the costs of all three components of the reengineered census. That is, all three components can be carried out at a cost that is no greater B and probably somewhat less B than the cost of repeating the Census 2000 process.

KEYWORDS: 2010 Census; Census 2000; Census Coverage; Reengineered Census.

1. DESPITE CENSUS 2000 SUCCESSES, REENGINEERING NEEDED

Census 2000 was an unprecedented operational success and was the most accurate census to date in terms of net coverage. It was completed on time and under budget with key operations functioning as planned. Analyses of Census 2000 operations indicate that they were efficient and effective, producing high quality data. Operational design improvements produced measurably better results over previous censuses. Although there were some local problems and minor operational shortcomings, Census 2000 operations were implemented in a controlled manner and within design expectations.

Moreover, the advertising campaign and the partnership program helped to produce a mail return rate of 74 percent, surpassing planners expectations considerably and halting a steady downward trend in public cooperation that had occurred since the Census Bureau first initiated a national mailout/mailback approach in 1970.² A high mail return rate is crucial to the success of the census B operationally, budgetarily, and also in terms of data quality; data from mailback questionnaires tend to be more complete and of higher quality than the data from forms completed by enumerators.

Given the successes of Census 2000, the Census Bureau is extremely encouraged about the prospects for the next census. However, despite these successes, Census 2000 was very costly and carried out with a high degree of operational risk. Given the rapid and dramatic demographic and technological changes that will continue to occur over this decade, it would be unwise to assume that the process of Census 2000 could be repeated in 2010 without incurring unacceptable risk and cost. Specifically, as we began our planning for the 2010 Census in the late 1990=s, we were concerned that our basic approach to census-taking may not allow us to continue to make progress in many important areas; our assessments of Census 2000 have confirmed that concern. While Census 2000 was the most successful census ever, it is clear that issues remain that cannot be resolved by repeating the current approach, even with the application of a greater amount of resources:

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²The figure cited here is the national mail return rate (includes both short and long form questionnaires) as of April 18, 2000, the cut-off date for creating the list of households for inclusion in the Nonresponse Followup (NRFU) operation. See Bureau of the Census, "Census 2000 Response and Return Rates B National and State by Form Type," by Herbert F. Stackhouse and James B. Treat, DSSD Census 2000 Procedures and Operations Memorandum Series L-10, 12 February 2002, 4, Table 1.

- ⊖ While coverage improved dramatically, additional progress needs to be made in reducing the levels of omissions and erroneous enumerations.
- ⊖ With regard to data on race and ethnicity, the percentage of respondents indicating “some other race” B rather than reporting one (or more) of the five specific race categories as required by most federal statistical programs B continued to increase.
- ⊖ While field operations were largely implemented in a controlled manner and within design expectations, they were very expensive and the volume of paper required was overwhelming.
- ⊖ While our maps were clearly better than in previous censuses, field workers still had great difficulty navigating in their assigned areas and correctly identifying the addresses to enumerate.
- ⊖ Out of a Nonresponse Followup (NRFU) workload of approximately 42 million households, enumerators visited nearly four million households that had already mailed in their questionnaires.³ This activity was costly and did not improve the census.
- ⊖ Our automated systems worked, but they were developed at high risk and without an established enterprise architecture.
- ⊖ Long form data were released earlier than ever before, but over the course of the decade since their last release, data users were still required to work with results that were, on average, seven years old.

In order to address these issues, we realized that we needed to determine a new direction for the 2010 Census; that is, the census would have to be “reengineered.” The 2010 re-engineering vision began with the identification of four major goals:

- ⊖ Increase the coverage, accuracy, and quality of census data
- ⊖ Reduce operational risk
- ⊖ Increase the relevance and timeliness of census long form data
- ⊖ Contain costs.

2. THE 2010 CENSUS RE-ENGINEERING PLAN⁴

Our plan for a reengineered 2010 Census consists of three highly integrated activities designed to dramatically improve upon what was a very good census in 2000. We will accomplish this by taking advantage of opportunities for innovation B made possible through the expanded use of technology B that will enable us to meet our above-stated goals for the 2010 Census.

The three integrated components are:

- 1) Collect and tabulate long form data every year throughout the decade through a large household survey called the American Community Survey (ACS);
- 2) Enhance and improve our existing Master Address File (MAF) and TIGER⁵ geographic data base by bringing them into alignment with true global positioning system (GPS) coordinates and converting our TIGER data base system to a commercial, off-the-shelf data base environment; and
- 3) A program of early and comprehensive planning, development and testing designed to completely restructure the management and conduct of a short form only census in 2010. This component will provide the savings needed to support the re-engineering initiative.

³Bureau of the Census, “Census 2000 Mail Return Rates,” by Herbert F. Stackhouse and Sarah Brady, Census 2000 Evaluation A.7.b, 30 January 2003, 13.

⁴Much of the initial discussion in this section is taken from “2010 Reengineering,” 5 February 2002.

⁵TIGER⁷ is the acronym for Topologically Integrated Geographic Encoding and Referencing.

2.1 The American Community Survey

Adopting the ACS as the planned replacement for the census long form will allow the short form only census to focus more directly on meeting our constitutional and statutory mandates for the collection and issuance of the apportionment and redistricting data. This will transfer to the ACS the responsibility to provide estimates of detailed demographic and housing data throughout the decade. These more timely and therefore more relevant data will greatly enhance the value of this information that federal, state, and local policymakers as well as businesses currently obtain from the once-in-a-decade long form.

The survey will include approximately three million households annually. Just like the census long form, the ACS will provide data on the following subjects: families, children, and the elderly; income and poverty; educational attainment and school enrollment; work and unemployment; disability; immigration and language ability; housing; and many more. It will provide annual estimates for all states, as well as for areas and population groups of approximately 65,000 people or more, starting in 2006. For smaller areas, it will take three to five years to accumulate sufficient samples to produce appropriate estimates. For example, for areas of approximately 20,000 to 65,000 people, three-year moving averages will be produced, starting in 2008. These multi-year estimates will be updated annually thereafter. For rural areas and city neighborhoods (census tracts and block groups) and other areas of less than 20,000 people, we will produce five-year moving averages, starting in 2010. These estimates will also be updated annually. Eventually, with sufficient multi-year estimates, we will be able to measure changes over time for small areas and population groups.

2.2 MAF/TIGER Enhancements Program

An updated MAF and an accompanying improved TIGER data base with GPS positional accuracy will allow the Census Bureau to maintain, with greater accuracy, the inventory and locations of all living quarters. In addition, we will greatly expand our ability to improve the accuracy of our census GIS systems that process these data. These MAF/TIGER enhancements are key to allowing the Census Bureau to adopt the technology necessary to fully utilize GPS-equipped hand-held mobile computing devices (MCDs) to update data on housing units and interview persons for the short form only census in 2010, thereby enabling us to take advantage of technological efficiencies to meet the census's constitutional mandate at a greatly reduced cost. The use of MCDs and their potential impact in terms of cost savings, improved data quality, and improved coverage are discussed in a subsequent section on key research areas of our early planning, development, and testing for the 2010 Census.

2.2.1 Improvements to Our Existing MAF/TIGER System Needed

A complete and accurate address system is absolutely essential to the success of the decennial census. In order to attempt to count and correctly locate every individual in the U.S. population, the Census Bureau has created and maintains a Master Address File (MAF) to identify all living quarters, and uses the TIGER data base to spatially locate these living quarters.⁶ The MAF includes addresses or location descriptions (for non-city style addresses, that is, units where there is no house number and street name) and census geographic information for each housing unit and group quarters. Each of these listings is linked to the TIGER data base. TIGER is essentially a "digital map" of the entire United States, showing the following: street center-lines and their names, lakes and streams and their names; railroad tracks; geographic entity boundaries, names, and codes; living quarters locations, locations of airports, schools, etc.; and ZIP Codes and address ranges (for streets with city-style addresses).

The location information in TIGER is of variable accuracy. That is, there are large, non-uniform differences in location accuracy that exist within relatively small areas, and there are no detailed quality measures that document the extent of street and address errors. Additionally, the existing MAF/TIGER system was internally developed and cannot be easily upgraded unless it is migrated to an open system that uses industry standard GIS software products.

⁶MAF/TIGER also contains similar information for living quarters in Puerto Rico and the Island Areas (American Samoa, the Commonwealth of the Northern Mariana Islands, Guam, and the U.S. Virgin Islands). In addition, the MAF contains address information on business establishments for our economic programs.

Consequently, to address these specific concerns and to make other improvements to our MAF/TIGER system, we have embarked on an Enhancements Program that consists of the following five objectives:

- ☐ Improve address/street location accuracy and implement automated change detection;
- ☐ Implement a modern processing environment;
- ☐ Expand and encourage geographic partnership options (with state, local, and tribal governments);
- ☐ Launch the Community Address Updating System B to improve our address lists in rural areas where the U.S. Postal Service=s Delivery Sequence File updates are not particularly useful because of the preponderance of non-city style addresses in these areas; and
- ☐ Implement periodic evaluation activities/expand quality metrics B for example, we are working on the development of a MAF/TIGER Error Model that would allow us to systematically analyze errors in the system.

2.3 Early 2010 Planning, Development and Testing

These two just-described components (the ACS and the MAF/TIGER enhancements) are truly exciting and innovative in their own right. But unless they can be translated into an improved 2010 Census and done so without expanding the cost of census-taking, the goals of the reengineered census will not be met.

The third component (early 2010 planning, development and testing) is essential to complete the picture. The new short form only census, which is the end goal of this component, is in fact the key component to the success of this reengineering effort. Without it, we are left with a census that improves relevance, but at a greatly expanded cost and with no serious reductions in operational risk or improvements in coverage accuracy.

By taking advantage of not having long form requirements for the 2010 Census, the potential cost of the 2010 short form only census can be greatly reduced and its accuracy greatly improved. Add to this the availability of a fully GPS-aligned MAF/TIGER system, which will allow us to fully realize the benefits of using MCDs for address listing, data collection and related activities, and we have the potential to completely restructure the data collection, data capture and data processing of the 2010 Census. The use of MCDs will enable us to dramatically reduce the size of the field infrastructure needed to carry out a census, mostly by decreasing considerably the amount of paper B questionnaires, address registers, maps, assignment sheets, etc. B used in the field and the huge staff and voluminous office space required to handle that paper. The result will be a census that is more focused on coverage and quality issues, less operationally risky and less costly.

This, however, will not happen automatically. A decennial census is a very complex task employing hundreds of thousands of temporary workers over a very short period of time and costing billions of taxpayer dollars. To do this successfully, procedures must be fully tested under census-like conditions and refined well in advance of Census Day. The early years of this component involve extensive planning, development, testing, revising and retesting of literally thousands of procedures needed to complete a successful census. We are planning to restructure many of these procedures to reduce costs and improve accuracy while keeping operational risk to a minimum. To do this, we are conducting special purpose tests throughout the decade, and planning a major field test in 2004, focusing primarily on improved methodologies for data collection and coverage. In 2006, we plan a second major field test, which will be a more complete methodological and functional test focusing on the full automation of key field operations. In 2008, we plan to conduct a full dress rehearsal of the new census, setting the stage for a 2010 Census that delivers on all of the goals of the re-engineering plan.

In addition to providing improved accuracy and reduced operational risk, we expect that the cost reductions in the early planning, development and testing component will be sufficient to offset the costs of all three components of the reengineered census. That is, all three components can be carried out at a cost that is no greater B and probably somewhat less B than the cost of repeating the Census 2000 process.

The Census Bureau=s early and comprehensive planning, development and testing for the 2010 Census is organized around eleven broad program areas. Key areas of research in some of these program areas are discussed below.

2.3.1 Coverage

In the area of coverage, our focus will be on improving the *accuracy* of census coverage. As was discussed earlier, in terms of net coverage, Census 2000 was the best census ever. However, net coverage estimates can mask high levels of gross error B the numbers of omissions and erroneous enumerations. In Census 2000, the Accuracy and Coverage Evaluation (A.C.E.) program failed to detect large numbers of erroneous enumerations (many of which were duplicates), leading to a substantial overstatement in the estimate of net undercount (the revised estimates indicate a small national net overcount⁷). For 2010, we hope to build on the evaluations and research work that was done in conjunction with considering the adjusted Census 2000 data for possible use for redistricting and other non-apportionment purposes.⁸ Additionally, the subsequent A.C.E. Revision II work has helped to inform the focus of our 2010 research relating to coverage issues. To improve coverage accuracy, we will have to reduce the numbers of erroneous enumerations and omissions. Additionally, in the area of differential net coverage, we realize that there is still more work to be done in closing the gap, given that the revised estimates for Census 2000 indicate a net overcount of 1.13 percent for non-Hispanic Whites, but a net undercount of 1.84 percent for non-Hispanic Blacks.⁹

To address these and additional coverage issues, we have organized our research around the following topic areas: unduplication (person and housing unit), residence rules, within-household coverage, housing unit coverage, and imputation.

One key concern of our coverage research will be to reduce the amount of person and housing unit duplication in the census. While some aspects of this research will involve examining ways to minimize the number of duplicates (persons and housing units) in the first place, other aspects will focus on developing the best methods for identifying and removing duplicates from the census counts.

In the 2004 Census Test, we will test a “real-time” unduplication (persons and housing units) operation that we will implement as soon as we begin receiving completed questionnaires. Part of this research will examine the extent to which we need to follow up with respondents to obtain additional information to resolve potential duplicates. Ultimately, we believe this research will lead to the development of a system for conducting unduplication on all census return information on a flow basis during the course of the census. Additionally, we are conducting research on improvements in questionnaire instructions that could potentially reduce the amount of housing unit and person duplication to begin with; these improvements will be tested in the 2006 Census Test. Finally, we will conduct simulation research to examine alternative ways to improve the matching of addresses for purposes of unduplicating housing units during the MAF-building process.

We are also reviewing our residence rules to examine how we: 1) present them on our questionnaires; 2) explain them to enumerators; and 3) can ensure consistency in communicating them across response modes (paper questionnaires versus Internet versus telephone interactive voice response (IVR)). And we are researching the possible revision of some of our residence rules, consistent with case law holdings related to this issue.

Last year, we conducted cognitive testing of alternative ways of presenting the residence rule information on the questionnaire. From that testing, we have identified the best alternative for use in the 2004 Test. We will conduct followup operations to determine the efficacy of these revisions to the presentation of the residence rules. Finally, any potential revisions to the residence rules themselves will be tested in the 2006 Census Test.

⁷Bureau of the Census, “Technical Assessment of A.C.E. Revision II,” 12 March 2003, ii.

⁸Although the Census Bureau rejected the use of the adjusted Census 2000 data for redistricting and other non-apportionment purposes, it did note, however, that it was possible that further research and analysis could yield revised A.C.E. estimates that could be used for programmatic and other purposes B for example, to improve future intercensal estimates. It was with this mind that the Census Bureau embarked upon additional research to further revise the A.C.E. estimates. This research work is known as A.C.E. Revision II and resulted in the revised estimates released in March 2003.

⁹“Technical Assessment of A.C.E. Revision II,” ii.

To improve within-household coverage, we have developed and cognitively tested several sets of coverage probes, the most promising of which we are testing in the 2004 Test. By conducting a followup operation based on the responses to these probes, we hope to learn more about household situations/areas where there is overcoverage or undercoverage. In addition, we will obtain relevant information to help us determine the feasibility of conducting such a followup operation during the census itself. Other areas of within-household coverage research will include efforts to improve methods for enumerating large or linguistically-isolated households and those with highly mobile members.

With regard to housing unit coverage, as part of a larger effort to develop coverage requirements for the quality and accuracy of MAF/TIGER, staff are conducting initial research in the 2004 Test on the accuracy requirements for GPS coordinates obtained in the field using MCDs. Among other research areas, we are also examining appropriate uses of administrative records for MAF activities such as validation and updating.

There are two main aspects to our imputation research, development and testing. First, we will attempt to minimize the number of NRFU cases requiring count imputation, through the use of automated edits on the MCDs. Also, we will monitor the results of NRFU in real-time so that we can minimize the amount of missing data (focusing on unknown population count cases) at the end of the census (perhaps by requiring followup contacts when certain missing data thresholds are met). We will be testing this approach in the 2004 Census Test, and then these techniques will be evaluated and refined as necessary for use in the 2006 Census Test.

Second, we will conduct simulations of Census 2000 data to develop methodologies for improving the accuracy of count and item imputation. We will then test these revised methodologies in the 2006 Test.

2.3.2 Questionnaire Content - Race and Ethnicity

The reengineered short form only census will allow us to focus more of our attention on issues relating to the accuracy and quality of the data, including obtaining as accurate data as possible on race and ethnicity.

The Office of Management and Budget (OMB) standards pertaining to race and ethnicity were revised just prior to Census 2000.¹⁰ The OMB standards are revisited periodically to ensure that they allow for the accurate collection and presentation of these data, given our Nation's ever-changing demographic profile. In accordance with the revised standards, for the first time, respondents in Census 2000 were allowed to select more than one of five basic race categories and/or indicate "some other race." The tabulation of data on race consequently posed particular challenges for comparisons to previous censuses, but the Census Bureau was able to develop methods for tabulating and presenting these data to meet the needs of data users while ensuring the statutorily-mandated confidentiality of individual data.

On the census questionnaire, the Census Bureau must determine the most appropriate way to ask the questions pertaining to race and ethnicity. We know that even subtle changes in the manner or in the order we ask these questions can affect the quality of the data we receive. As mentioned earlier, the Census Bureau is concerned about the growing percentage of respondents who solely indicate "some other race." The implications and consequences of allocating these individuals to specific races when conducting analyses across federal statistical system data series (most other federal statistical programs require reporting one (or more) of the five race categories specified in the OMB standards) become increasingly significant as this percentage grows. Consequently, we are in the process of conducting research on the possible effects of removing the "some other race" category. Other research questions relating to race and ethnicity that we are also examining in a number of early tests include:

- ☐ Can we improve the data by revising the instructions for the race and ethnicity questions and/or modifying the wording of the questions?
- ☐ On the census questionnaire, should we attempt to explain the intent of these questions?
- ☐ Does adding examples of subgroups (in addition to those that already appear as response categories) for the questions on Hispanic origin and race result in greater reporting of specific ethnicities?

2.3.3 Language Program

¹⁰Executive Office of the President, Office of Management and Budget, "Revisions to the Standards for the Classification of Federal Data on Race and Ethnicity," Federal Register (30 October 1997) vol. 62, no. 210, 58782-90.

The Census 2000 Language Program included the availability of: (1) questionnaires in five other languages (Spanish, Chinese, Vietnamese, Tagalog, and Korean) in addition to English, and (2) language assistance guides, visual aids to assist respondents in completing the short and long form questionnaires, in 49 languages.

In planning for the 2010 Census, it is our expectation that we can increase the response rate and improve the quality of census data by allowing people to respond to the census in the language that they are most comfortable with. Additionally, a short form only census provides us with the opportunity to expand our Language Program.

We have already conducted some initial research on the use of a bi-lingual Spanish/English questionnaire. The cognitive and focus group testing focused on the usability of different layouts of a bilingual English/Spanish short form, but the Census Bureau also gained some general feedback on the use of such a form. Note that while the feedback gained is useful, the Census Bureau will have to engage in formal testing of a bilingual Spanish/English questionnaire before we can draw reliable conclusions regarding its potential impact. Therefore, we will continue to pursue our research and testing in this important area.

Other areas of research related to our Language Program include: investigating methods for improving the translation of questionnaires and language assistance guides, and the delivery/distribution of these materials; exploring the feasibility of providing multiple language capability across various response modes (Internet, telephone IVR, and MCD); and developing and incorporating improved techniques and procedures for conducting interviews with non-English speaking households.

2.3.4 Special Place/Group Quarters

Staff of the 2010 Census Special Place (SP)/Group Quarters (GQ) Planning Group are researching the best ways for appropriately defining living quarters as housing units or group quarters, including reviewing and revising our definitions as necessary. In Census 2000, we found that unclear definitions led to the misclassification of certain types of living quarters. In the 2004 Census Test, we will be testing components of a new frame (inventory) development strategy in an operation called Group Quarters Validation. Enumerators will visit each identified "other living quarters" (living quarters determined not to be housing units during an address canvassing operation) and conduct an interview to determine, through a series of questions, whether the address is in fact a GQ, a housing unit, or not a living quarters (for example, a commercial establishment). This new operation and its associated data collection instrument are designed to help us understand the kinds of misclassification errors that occur and suggest improvements to our housing unit and group quarters definitions that will result in clear field procedures for listing and enumerating all types of living quarters.

In Census 2000, putting our SP/GQ concepts and definitions into operation also posed problems in instances where a special place and one or more of its associated group quarters were in different local census office areas. While maintaining the link between a special place and its associated group quarters, our strategy for the 2010 Census will be to focus frame development, enumeration, and processing activities on the group quarters units themselves.

Additionally, the frame development process for group quarters suffered from overlapping update operations that resulted in decreased effectiveness in verifying and unduplicating the SP/GQ inventory. Consequently, for 2010, we are researching ways to improve the integration of SP/GQ addresses with housing unit addresses in the Master Address File, so as to ensure, to the greatest extent feasible, uniform quality requirements for living quarters information contained in the MAF.

2.3.5 Mobile Computing Devices

Researching the use of MCDs for address list development, data collection and related activities is an important part of our early planning, development and testing for the 2010 Census. In addition to reducing the amount of paper and the infrastructure costs associated with handling it, mostly by providing electronic data collection, we expect that the use of MCDs will reduce interviewer mileage and travel time, reduce the NRFU workload, and result in improved data quality.

The MCDs will play a crucial role in a much more efficient assignment management system. Among other things, a greatly improved assignment management system will enable enumerators to receive on their MCDs daily assignment

updates. In Census 2000, it is estimated that enumerators visited nearly four million households that had already mailed back their questionnaires, because the field workers did not have updated information on nonresponding households. Also, we expect that the GPS-equipped devices will enable enumerators to navigate to and within their assignment areas more easily, and to locate with less difficulty specific housing units in those areas. Additionally, the use of MCDs will result in improvements in data quality by enabling us to implement automated edits and conduct quality assurance as we collect data from respondents during NRFU. Finally, the Census Bureau is researching the use of MCDs for payroll data entry and processing and other administrative functions relating to field enumerator activities.

3. KEY LESSONS LEARNED FROM 2000 ARE ADDRESSED IN OUR PLAN

Our examination of the issues discussed at the outset of this section led to the identification of the following lessons learned as we developed our re-engineering plan for 2010:

- ☐ If we want to achieve our 2010 Census goals, operational testing of design infrastructure must start early in the decade and continue through the dress rehearsal;
- ☐ If we want to save money in the 2010 Census, we must do so in the field;
- ☐ If we want to save money in the field, we must reduce workload, paper and people; and
- ☐ If we want quality improvement, we must reduce operational risk in our information technology (IT) systems, and simplify enumerator work assignments.

Our re-engineering strategy for the 2010 Census specifically addresses these lessons learned. For example, the planned use of MCDs for address list development, data collection and related activities speaks directly to the second and third items, and to the last part of the fourth item in this list. Our plan is an ambitious one and will require significant investments early in the decade to address these lessons learned and thereby enable us to achieve our goals for the 2010 Census.

4. CONCLUSION

Census 2000 was the most successful census ever, both operationally and in terms of net coverage. These successes occurred despite a significantly reduced program of early development and testing, particularly with regard to systems infrastructure, that exposed the census to a high degree of operational risk. In addition, Census 2000 was very costly. At the same time, it is clear that issues remain that cannot be resolved by simply expending more resources while repeating the current approach to census-taking. Additionally, we will face new challenges that will increase enumeration complexity in 2010, given the rapid and dramatic demographic, technological and other societal changes that are underway and will continue through the end of the decade. We believe that our re-engineering plan will enable us to both resolve existing issues and meet these new challenges, resulting in a 2010 Census that surpasses what we were able to accomplish in Census 2000.

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