### Description of National Genetic Evaluation Systems

<table>
<thead>
<tr>
<th>Country (or countries)</th>
<th>United States of America</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Trait Group</td>
<td>Female fertility (HCR), calving to first insemination (CFI), cow conception rate (CCR), daughter pregnancy rate (DPR)</td>
</tr>
<tr>
<td>Breed(s)</td>
<td>AYS (RDC), BSW, GUE, HOL (B&amp;W, R&amp;W), JER, MSH (RDC); single-breeds evaluations for HCR and CCR; all breeds and crossbred cows evaluated together in a multibreed AM for DPR</td>
</tr>
</tbody>
</table>
| Trait definition(s) and unit(s) of measurement | **HCR:** Maiden heifer’s ability to conceive (trait 1) defined as percentage of inseminated heifers that become pregnant at each service; an HCR of 1 implies that daughters of this bull are 1% more likely to become pregnant as a heifer than daughters of a bull with an evaluation of 0  
**CFI:** Lactating cow’s ability to start cycling (trait 2) defined as days from calving to first insemination; estimated as a linear function of PTA for CCR and DPR instead of directly from raw data  
**CCR:** Lactating cow’s ability to conceive (trait 3) defined as percentage of inseminated cows that become pregnant at each service; a CCR of 1 implies that daughters of this bull are 1% more likely to become pregnant during that lactation than daughters of a bull with an evaluation of 0  
**DPR:** Lactating cow’s interval calving–conception (trait 5) defined as percentage of nonpregnant cows that become pregnant during each 21-day period; a DPR of 1 implies that daughters from this bull are 1% more likely to become pregnant during that estrus cycle than a bull with an evaluation of 0; each increase of 1% in PTA DPR equals a decrease of 4 days in PTA DPR |
| Method of measuring and collecting data | Collected by Dairy Herd Improvement Affiliates using ICAR-approved methods |
| Time period for data inclusion | **HCR:** Calvings from 2003 and later  
**CCR:** First calvings from 2003 and later  
**DPR:** First calvings from 1960 and later |
| Age groups (e.g. parities) included | **HCR:** Only breedings for which heifer is at least 1 but <2.2 years old included  
**CCR:** First 5 parities included; only breedings for which cow is at least 2 years old included  
**DPR:** First 5 parities included |
| Other criteria (data edits) for inclusion of records | HCR: All confirmed (failure or success) breedings* up to 7 included; herd-year conception rate must be between 10 and 90%; known sire required; known ET heifers excluded; heifers must be 97% purebred to be evaluated; within-breed matings required  
CCR: All confirmed (failure or success) breedings* up to 7 included; herd-year must report at least 1 breeding for at least 50% of milking cows and conception rate must be between 10 and 90%; known sire required; known ET cows excluded; cows must be 97% purebred to be evaluated; within-breed matings required  
DPR: Records for pregnancy rate considered complete at 250 DIM; pregnancy status after 250 DIM used, but records set to 250 DO; date pregnant set to 50 DIM for cows that become pregnant before 50 DIM; some extremely early pregnancy dates obtained by calculation from date of next calving inaccurate because of short gestation lengths or unreported abortions; lower (50) and upper (250) limits applied after adjusting DO for season effects and affect 5 and 14% of records, respectively  
*Service coded as failure if another reproductive event (breeding–AI or NS, heat, or diagnosis of “not pregnant”) subsequently reported or as success if validated with a pregnancy check or resulting calving date |
| Criteria for extension of records (if applicable) | DPR: DIM ≥ 130 and <250 predicted |
| Sire categories | All sires (AI and NS) evaluated together |
| Environmental effects, pre-adjustments | DPR: Season adjustments based on month fresh; heterogeneous variance adjustments use same procedures developed for yield traits |
| Method (model) of genetic evaluation | HCR: ST BLUP RP AM within breed  
CCR: ST BLUP RP AM within breed  
DPR: Multibreed BLUP AM; all breeds and crossbreds evaluated |
| Environmental effects³ in the genetic evaluation model | HCR: Management group (flexible HYS-registry status) (F), year-State-breeding month (F), service number (F), heifer breeding age (F), short cycle (breeding ≤ 17 days after last service) (F), mating type (F), PE (R)  
CCR: Management group (flexible HYS-parity-registry status) (F), parity (F), year-State-breeding month (F), service number (F), cow age (F), short cycle (F), mating type (F); PE (R)  
DPR: Management group (flexible HYS, includes registry status for HOL) (F), parity x age (F), regression on inbreeding (F), PE (R), herd × sire interaction (R); released PTA includes regression coefficient multiplied by expected future inbreeding (EFI) and coefficient of heterosis when mated to purebred as a post-processing step |
<p>| Adjustment for heterogeneous variance in evaluation model | DPR: Herd-year variances adjusted to equal first-parity variance of cows calving in 2007 (base year + 2) using the same methods developed for yield traits |</p>
<table>
<thead>
<tr>
<th>Use of genetic groups and relationships</th>
<th>DPR: Unknown parents grouped by birth year, breed, and, for HOL, separately for U.S. and foreign animals; unknown sires and dams of cows grouped separately, but unknown parents of bulls in a combined group; separate unknown-parent groups used for R&amp;W and B&amp;W HOL; relationship matrix accounts for effects of inbreeding on Mendelian sampling variance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blending of foreign/Interbull information in evaluation</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Genetic parameters in the evaluation</td>
<td>See Appendix GE for $h^2$/genetic variance estimates and “calculation of reliability” section below for use in calculation;</td>
</tr>
</tbody>
</table>
| | **HCR:** PE variance, 0.025; RP, 0.12  
**CCR:** PE variance, 0.012; RP, 0.07  
**DPR:** PE variance, 0.12, herd × sire interaction; 0.04, RP, 0.20 |
| System validation | Means and SDs for all variables calculated and examined overall; means for new bulls, changes for high bulls, largest changes, and key statistics for recent AI bulls checked; genetic trends for each breed validated by methods 1, 2, and 3 |
| Expression of genetic evaluations | PTA, % for HCR, CCR, and DPR; PTA, days for CFI  
**HCR:** PTA = within-breed PTA – breed mean  
**CFI:** PTA = 1.2(PTA CCR) – 3.6(PTA DPR)  
**CCR:** PTA = within-breed PTA – breed mean  
**DPR:** All-breed PTAs adjusted to within-breed bases as within-breed PTA = (all-breed PTA – breed mean) × (breed SD/HOL SD) |
| Definition of genetic reference base  
Next base change | **HCR:** All evaluated bulls (rolling, every evaluation)  
**CCR:** All evaluated bulls (rolling, every evaluation)  
**DPR:** Cows born in 2005 (stepwise, 5 years)  
April 2015 (when base will be cows born in 2010) |
**CFI:** 0.37(CCR reliability) + 0.63(DPR reliability)  
**DPR:** Daughter equivalents from progeny, parents, and own records combined using the same methods as for yield traits; currently verified and nonverified records receive the same weight |
| Criteria for official publication of evaluations | At least 10 daughters with usable fertility data |
| Number of evaluations/publications per year | 3 (April, August, December) |
| Use in total merit index⁴ | **DPR:** 11% of total in net merit dollars (NM$, all breeds); 10% of total in Total Performance Index (TPI, HOL) |
Anticipated changes in the near future

Additional genetic evaluations for days from first to last insemination

Key reference on methodology applied


Key organisation: name, address, phone, fax, e-mail, web site

Animal Improvement Programs Laboratory
Agricultural Research Service, U.S. Dept. of Agriculture
Bldg. 005, Room 306, BARC-West
10300 Baltimore Ave.
Beltsville, Maryland 20705-2350, USA
Voice: 301-504-8334; Fax: 301-504-8092
E-mail: aipl.inquiry@ars.usda.gov
web site: http://aipl.ars.usda.gov
### Parameters used in genetic evaluation

**Country (or countries):** United States of America  
**Main trait group:** Female fertility (HCR, CFI, CCR, DPR)  
**Breed(s):** AYS (RDC), BSW, GUE, HOL (B&W, R&W), JER, MSH (RDC)

<table>
<thead>
<tr>
<th>Trait</th>
<th>Definition</th>
<th>ITB</th>
<th>$h^2$</th>
<th>Genetic variance</th>
<th>Official proof standardisation formula*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maiden heifer’s ability to conceive</td>
<td>Heifer conception rate (HCR)</td>
<td>X</td>
<td>0.01</td>
<td>SD = 0.0481</td>
<td>(all breeds)</td>
</tr>
<tr>
<td>Lactating cow’s ability to start cycling</td>
<td>Calving to first insemination (CFI)</td>
<td>X</td>
<td>0.066</td>
<td>SD = 9.1</td>
<td>(all breeds)</td>
</tr>
<tr>
<td>Lactating cow’s ability to conceive 1</td>
<td>Cow conception rate (CCR)</td>
<td>X</td>
<td>0.016</td>
<td>SD = 0.0581</td>
<td>(all breeds)</td>
</tr>
<tr>
<td>Lactating cow’s ability to conceive 2</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Lactating cow’s interval calving-conception</td>
<td>Daughter pregnancy rate (DPR)</td>
<td>X</td>
<td>0.04</td>
<td>BSW SD = 3.05</td>
<td>GUE SD = 3.04</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>HOL SD = 3.02</td>
<td>JER SD = 3.02</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>RDC SD = 3.01</td>
<td>—</td>
</tr>
</tbody>
</table>

*Expressed as follows:  
StandEval = ((Eval − a)/b) × c + d, where a = mean of base adjustment, b = SD of base, c = SD of expression (include sign if scale is reversed), and d = base of expression.