Summary of Studies Supporting USDA Product Licensure

Establishment Name	Zoetis Inc.
USDA Vet Biologics Establishment Number	190
Product Code	1071.23
True Name	Bovine Rhinotracheitis-Parainfluenza 3-Respiratory Syncytial Virus Vaccine, Modified Live Virus
Tradename(s) / Distributor or Subsidiary (if different from manufacturer)	Inforce 3 - No distributor specified Inforce 3 - Zoetis Industria Produtos Veterinarios Ltda. Inforce 3 - Zoetis Korea Inforce 3 - Zoetis Russia Inforce 3 - Zoetis South Africa Ltd Inforce 3 - Zoetis Veterinary Products Industry TSV-3 - Zoetis Japan Inc. TSV-3 - Zoetis Mexico
Date of Compilation Summary	February 22, 2023

Disclaimer: Do not use the following studies to compare one product to another. Slight differences in study design and execution can render the comparisons meaningless.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Herpesvirus type -1, bovine [Infectious bovine rhinotracheitis (IBR) virus</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against respiratory disease caused by infectious bovine rhinotracheitis (IBR) virus</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in 2 nostrils</td></tr>
<tr><td>Study Animals</td><td>20 vaccinates, and 10 controls calves, 7-9 months of age and IBR sero-negative (serum neutralizing antibody titer < 1:2)</td></tr>
<tr><td>Challenge Description</td><td>IBR virus administered 28 days after vaccination (Study Day 28)</td></tr>
<tr><td>Interval observed after challenge</td><td>Cattle were monitored daily for clinical signs, and rectal temperature for 14 days following challenge. Nasal swabs for virus isolation were collected on the day before challenge, one day post challenge through Day 14 post challenge.</td></tr>
<tr><td>Results</td><td>Animals were considered affected by acute IBR disease if they showed one or more clinical signs (depression, and/or mucopurulent nasal discharge, and/or increased respiratory effort and/or sounds). Animals showing no clinical signs or mild (serous) nasal discharge and/or mild lethargy on any post challenge days were designated unaffected.

<u>Number of animals affected and % (IBR disease):</u>

<table>
<tr><th>Treatment Group</th><th>IBR Disease Affected</th><th>Percent (%) Affected</th></tr>
<tr><td>Controls</td><td>10/10</td><td>100</td></tr>
<tr><td>Vaccinates</td><td>1/20</td><td>5</td></tr>
</table>

See tables attached for individual animal data on clinical signs of acute IBR disease.</td></tr>
<tr><td>USDA Approval Date</td><td>01/12/2010</td></tr>
</table>

Clinical signs of acute IBR disease on days post challenge:

Treatment Group	Animal ID	Day of Study (Day 28 was day of challenge)													
		29	30	31	32	33	34	35	36	37	38	39	40	41	42
CONTROLS	102	NO	NO	NO	NO	NO	YES	YES	NO	NO	NO	NO	NO	NO	NO
	106	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO
	111	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
	117	NO	NO	NO	YES	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO
	127	NO	NO	NO	NO	YES	YES	YES	YES	YES	YES	NO	NO	NO	NO
	130	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
	138	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO
	139	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	NO	NO
	141	NO	NO	NO	NO	YES	YES	YES	YES	NO	NO	NO	NO	NO	NO
	146	NO	NO	NO	NO	YES	YES	YES	YES	YES	NO	NO	NO	NO	NO
VACCINATES	101	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	109	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	110	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	113	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	114	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	115	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	116	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	119	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	120	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	122	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	123	NO	NO	NO	NO	NO	YES	YES	YES	NO	NO	NO	NO	NO	NO
	124	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	125	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	128	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	131	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	132	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	136	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	140	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	149	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	150	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

YES: Animal Affected; NO: Animal not Affected
The highlighted cells are positive for animal showing clinical signs of IBR disease.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Herpes virus, Bovine [bovine rhinotracheitis (IBR) virus]</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate a duration of immunity of at least 193 days against respiratory disease caused by infectious bovine rhinotracheitis (IBR) virus</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in one (1) nostril</td></tr>
<tr><td>Study Animals</td><td>19 vaccinated, and 20 control calves, 3-4-day old and seronegative to IBR (serum neutralizing antibody titer < 1:2)</td></tr>
<tr><td>Challenge Description</td><td>On day 193 post vaccination, the animals were challenged with IBR virus (Study Day 193)</td></tr>
<tr><td>Observation interval after challenge</td><td>Animals were observed daily for 14 days post challenge for clinical signs and rectal temperatures were recorded. Blood was collected for serology before challenge, and on the last day of observation. Nasal secretions were collected for IBR virus isolation before challenge and through the end of the study.</td></tr>
<tr><td>Results</td><td>Calves were considered affected by IBR disease if an animal developed pyrexia, defined as a body temperature of ≥104.0°F for at least two days, and demonstrated depression, respiratory effort (dyspnea) and / or nasal discharge (scores of 1) during the post-challenge observation period.

<u>Number of animals affected and % (IBR disease):</u>

<table>
<tr><th>Treatment Group</th><th>Number of Calves Affected</th><th>Percent Affected (%)</th></tr>
<tr><td>Controls</td><td>13/20</td><td>65 %</td></tr>
<tr><td>Vaccinates</td><td>3/19</td><td>15.8 %</td></tr>
</table>

See individual animal data attached for IBR disease clinical scoring and rectal temperature.</td></tr>
<tr><td>USDA Approval Date</td><td>07/29/2016</td></tr>
</table>

IBR Disease: Depression

Treatment Group	Animal ID	Study Day (Challenge was on Day 193)													
		194	195	196	197	198	199	200	201	202	203	204	205	206	207
CONTROLS	677	0	0	0	0	1	0	1	1	1	0	0	0	0	0
	682	0	0	0	0	0	1	1	1	0	0	0	0	0	0
	683	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	686	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	688	0	0	0	0	0	1	0	0	0	0	0	0	0	0
	690	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	691	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	693	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	695	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	703	0	0	0	0	1	1	1	0	0	0	0	0	0	0
	705	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	709	0	0	0	0	0	0	0	1	1	1	1	0	0	0
	712	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	717	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	719	0	0	0	0	0	1	0	1	0	0	0	0	0	0
	724	0	0	0	0	1	1	1	1	1	1	1	0	0	0
	725	0	0	0	0	0	1	0	0	1	1	0	0	0	0
	726	0	0	0	0	1	0	0	0	1	0	1	0	0	0
	727	0	0	0	0	0	1	1	1	1	1	0	0	0	0
	729	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACCINATES	678	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	687	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	689	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	694	0	0	0	1	1	1	0	0	0	0	0	0	0	0
	697	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	700	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	701	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	702	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	704	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	707	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	710	0	0	0	0	1	1	0	1	0	1	1	0	0	0
	711	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	713	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	714	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	716	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	718	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	721	0	0	0	0	0	0	0	0	0	0	1	0	0	0
	730	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Clinical scoring:
0 = Normal.
1 = Abnormal. Animal tends to stand with head lower than pen mates. Has a dull appearance in one or both eyes; one or both ears may droop lower than ears of pen mates. Animal is lethargic with movements and responses to stimuli that are slow, hesitant or unsteady. Animal has a reduced interest in surroundings and may stand off from pen mates or from feed. If recumbent, animal is markedly slower in rising and rises (maybe unsteadily) with increased effort; Scores of 1 are highlighted in yellow in the table above.
The highlighted cells are showing animals with clinical scoring of depression ≥ 1.

IBR Disease: Nasal Discharge

Treatment Group	Animal ID	Study Day (Challenge was on Day 193)													
		194	195	196	197	198	199	200	201	202	203	204	205	206	207
CONTROLS	677	0	0	0	0	0	0	1	1	1	0	0	0	0	0
	682	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	683	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	686	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	688	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	690	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	691	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	693	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	695	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	703	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	705	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	709	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	712	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	717	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	719	0	0	0	0	0	1	1	1	0	0	0	0	0	0
	724	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	725	0	0	0	0	0	0	0	0	1	0	0	0	0	0
	726	0	0	0	0	0	0	0	0	1	1	0	0	0	0
	727	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	729	0	0	0	0	0	0	0	0	0	0	0	0	0	0
VACCINATES	678	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	687	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	689	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	694	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	697	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	700	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	701	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	702	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	704	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	707	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	710	0	0	0	0	0	0	0	1	0	1	0	0	0	0
	711	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	713	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	714	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	716	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	718	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	721	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	730	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Clinical scoring:
0 = Normal
1 = Abnormal. Notable amount (approx. ≥ 5 mL) of mucopurulent discharge accumulated in or running out of the nostrils; Scores of 1 are highlighted in yellow in the table above.
The highlighted cells are showing animals with clinical scoring of nasal discharge ≥ 1.

IBR Disease: Respiratory Effort

Treatment Group	Animal ID	Study Day (Challenge was on Day 193)													
		194	195	196	197	198	199	200	201	202	203	204	205	206	207
CONTROLS	677	0	0	0	0	1	0	1	0	1	0	0	0	0	0
	682	0	0	0	0	0	1	1	1	1	0	0	0	0	0
	683	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	686	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	688	0	0	0	1	1	1	1	0	0	0	0	0	0	0
	690	0	0	0	0	0	1	0	0	1	0	0	0	0	0
	691	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	693	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	695	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	703	0	0	0	0	0	0	1	0	0	0	0	0	0	0
	705	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	709	0	0	0	0	0	1	0	1	1	1	1	0	0	0
	712	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	717	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	719	0	0	0	0	0	1	1	0	0	0	0	0	0	0
	724	0	0	0	0	1	1	1	1	1	1	1	0	0	0
	725	0	0	0	1	0	1	0	0	0	0	0	0	0	0
	726	0	0	0	1	1	1	0	0	1	1	1	0	0	0
	727	0	0	0	0	1	1	1	1	1	1	0	0	0	0
	729	0	0	0	0	0	0	0	0	1	0	0	0	0	0
VACCINATES	678	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	681	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	687	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	689	0	0	0	1	0	0	0	0	0	1	0	0	0	0
	694	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	697	0	0	0	0	0	0	0	0	0	1	0	0	0	0
	700	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	701	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	702	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	704	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	707	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	710	0	0	0	0	1	1	0	0	0	1	1	0	0	0
	711	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	713	0	0	0	1	0	0	0	0	0	0	0	0	0	0
	714	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	716	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	718	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	721	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	730	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Clinical scoring:
0 = Normal.
1 = Abnormal. Respiratory character may be deep, and primarily abdominal or markedly shallow and rapid. Breathing may be audible as raspy or with an expiratory “grunt” during exhalation.; Scores of 1 are highlighted in yellow in the table above. The highlighted cells are showing animals with clinical scoring of respiratory effort ≥ 1.

Rectal Temperatures (°F)

Treatment Group	Animal ID	Study Day (Challenge was on Day 193)													
		194	195	196	197	198	199	200	201	202	203	204	205	206	207
CONTROLS	677	101.8	101.8	103.7	105.5	106.5	104.8	103.5	102.3	102.4	101.6	101.8	101.2	101.5	101.9
	682	101.8	102.8	105.2	106.2	106.1	105.5	104.2	104.1	104.1	103.5	102.6	101.6	101.5	101.8
	683	101.2	102.4	105.9	105.8	104.1	103.4	102.2	102.9	101.8	101.3	101.2	101.3	101.3	101.6
	686	101.8	101.6	105.7	106.9	106.6	105.2	103.1	103.1	103.1	102.9	102.2	101.2	101.6	101.9
	688	101.5	102.6	104.2	105.1	105	104.1	103.1	102	101.9	101.8	101.4	101	101.3	101.2
	690	101.7	101.4	103.3	104.5	104.6	103.8	103.2	103.4	102.7	101.8	101.7	101.6	101.8	101.7
	691	101.2	101.7	105	106.5	105.5	105	103.3	102.7	102.5	101.6	101.4	101.4	101.3	101.6
	693	101.8	102	103.9	105.8	106.7	106	104.6	103.2	102.9	102.1	101.7	101.6	101.3	101.6
	695	101.2	103.2	105.6	103.7	105.2	104.5	102.7	104.1	103.3	102	101.8	101.2	101.6	101.2
	703	101.3	102.4	104.5	105.5	105.8	103.3	101.8	103.1	102.3	101.1	101.3	100.9	102.3	101.3
	705	101.5	101.8	103.9	104.1	106	103.4	102.5	101.4	102	101.2	101.1	101.3	101.2	100.9
	709	101.6	102	104.5	106	105.8	104.8	103.7	104.5	103.9	103.2	102.4	101.8	101	101
	712	101.4	102.6	104.8	105.6	105.2	103	101.7	101.3	100.8	101.2	101.2	100.8	101	101.1
	717	101.4	101.5	103.4	105.5	104.1	103.3	102.6	102.4	102.1	101.2	101.4	101.3	101.4	101.4
	719	101.7	102.7	104.4	105.8	105.2	103.7	102.3	102.5	101.4	102.1	101.5	101.1	101.4	102.1
	724	102	103.6	106.4	105.8	105.7	105.3	103.1	103.6	103.6	102.8	102.3	101.7	101.4	101.5
	725	101.6	102	105.1	104.8	106.3	106.2	104.7	104.1	104.6	103	101.2	101.4	100.9	101.1
	726	.ND*	101.5	103.2	105.5	105.3	104.4	103	102.6	103.1	101.1	101.5	101	101.3	101.5
	727	101.4	103.9	104.5	105.3	104.7	104.1	105.1	105.1	102.6	101.3	101.5	101.4	101.3	101.8
	729	101.5	100.7	104.2	106.1	105.1	103.4	102.9	101.9	101.9	101	101.2	101.1	101	101.4
VACCINATES	678	101.8	103.1	105.4	105.6	105.4	103.3	101.8	102.1	101.4	101.7	101.7	101.3	101.2	101.9
	681	101.6	103.3	105.3	104.8	105.5	103.4	102.2	102.2	102.2	101.5	102.3	101.4	101.6	102.2
	687	101.6	102.3	104.2	105.2	103.6	102.7	101.7	101.7	101.9	101.3	102.2	101.9	101.5	102.1
	689	101.9	102.9	102.6	104.7	103	102	101.7	101.5	101.5	101.5	101.8	101.6	101.7	102.2
	694	101.7	104.5	106.3	105	103.7	102.6	102.2	101.6	101.7	101.5	101.7	102	101.4	101.6
	697	101.3	101.9	104	104.2	103.9	102.2	101.4	102.1	101.7	101.8	101.6	101.6	101.2	101.4
	700	101.6	103.1	104.7	104.9	103.8	102.7	102.1	101.7	101.7	101.7	101.5	101.4	101.6	101.5
	701	101.5	102.1	103.5	104.8	104	102.4	101.4	101.2	101.2	101.3	101.3	100.9	101.3	101.9
	702	101.4	102.6	104.3	104	102.9	102.3	101.5	101.2	101.5	101.6	101.6	101.4	101.2	101.8
	704	102	102	103.3	103.8	102.2	101.7	101.5	101.5	101.5	101.6	101.7	101.6	101.5	101.9
	707	101.7	102.2	103.8	103.2	105	101.8	101.5	101.2	101.2	101.6	101.5	101.5	101	101.1
	710	101.4	102.1	104.2	104.3	103.1	101.7	101.1	101.4	101.5	101.5	101.7	100.8	101.1	100.9
	711	101.8	102.2	105	104.7	103.9	102.5	101.7	101.6	101.1	101.5	101.5	101.2	101.3	101.2
	713	101.2	101.8	103.1	103.2	103.4	103	101.4	101.5	101.3	101.1	101.2	101	101.8	100.9
	714	101.5	104	104	105	104.7	103.8	102	101.7	101.5	101.4	101.4	100.9	101	101.2
	716	101.3	102.6	106.2	105	103.7	102	101	101.2	100.9	101	101.3	101.1	100.9	100.9
	718	101.7	102.5	103.3	102.9	103.4	102	101.8	101.1	101.7	101	101.6	101.5	101.8	102.1
	721	101.8	101.9	103.9	105	103.8	102.4	101.7	101.3	101.7	101.7	101.5	101.5	101.6	101.2
	730	101.5	101.6	103.5	103.9	103.9	102.3	101.7	101.4	101.7	101.4	101.8	101.2	101.1	101.7

Highlighted data indicates rectal temperature ≥104.0◦F

*ND=Rectal temperature was inadvertently not collected for this calf on this study day.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Bovine Parainfluenza type 3 (PI $_3$) virus</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against respiratory disease caused by PI_3 virus</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in two (2) nostrils</td></tr>
<tr><td>Study Animals</td><td>24 vaccinates, and 12 control calves, 8 month of age and seronegative to PI_3 [serum neutralizing (SN) antibody titer < 1:2]</td></tr>
<tr><td>Challenge Description</td><td>PI_3 virus administered 28 days after vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Calves were observed daily for 14 days following challenge. Nasal swabs for virus isolation were collected on the day before challenge and post challenge daily through the end of the study.</td></tr>
<tr><td>Results</td><td>Duration of shedding of PI_3 virus was evaluated.

<u>Duration of shedding in Days (5 number-summary):</u>

<table>
<tr><th>Treatment Group</th><th>Minimum</th><th>25th Percentile</th><th>Median</th><th>75th Percentile</th><th>Maximum</th></tr>
<tr><td>Controls</td><td>6</td><td>6</td><td>6.5</td><td>9.5</td><td>11</td></tr>
<tr><td>Vaccinates</td><td>1</td><td>4</td><td>5</td><td>6</td><td>10</td></tr>
</table>

See attached table for individual animal shedding data.</td></tr>
<tr><td>USDA Approval Date</td><td>05/20/2009</td></tr>
</table>

Virus isolation on days post challenge in log 10 TCID50 /mL:

Animal ID	Study Days (Challenge was on Day 28)												
	27	29	30	31	32	33	34	35	36	37	38	39	40*
CONTROLS													
3413	<1.09	2.64	4.98	5.56	6.54	5.17	2.45	<1.09	<1.28	<1.09	1.87	1.87	<1.09
3426	<1.09	<1.09	2.26	3.03	6.34	4.98	4.78	1.67	<1.09	<1.09	<1.09	<1.09	<1.09
3428	<1.09	2.45	4.78	6.15	5.56	6.15	5.56	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3430	<1.09	2.06	4.01	4.2	4.98	5.37	2.84	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3431	<1.09	2.45	3.03	3.03	3.62	5.37	5.95	1.48	<1.09	<1.28	<1.09	<1.09	<1.09
3435	<1.09	1.67	3.42	4.59	4.98	5.17	5.56	2.45	<1.09	<1.09	<1.09	1.87	<1.09
3438	<1.09	2.84	4.4	5.95	5.95	6.15	4.2	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3443	<1.09	3.03	3.42	6.15	5.76	6.15	4.2	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3480	<1.09	1.48	2.26	5.76	5.56	5.17	3.03	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3483	<1.09	2.06	2.84	4.59	5.17	5.56	4.59	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09
3484	<1.09	1.67	2.64	3.81	5.56	5.37	3.81	<1.09	<1.09	<1.09	1.87	<1.09	<1.09
3489	<1.09	<1.09	3.03	4.4	4.78	4.59	4.4	1.48	2.06	<1.09	<1.09	<1.09	<1.09
VACCINATES													
3412	<1.09	2.45	2.26	2.06	<1.09	<1.09	2.45	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3421	<1.09	<1.09	<1.09	<1.28	<1.28	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3427	<1.09	1.87	2.26	2.26	1.87	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3429	<1.09	2.45	1.67	1.87	2.45	<1.28	<1.09	<1.09	1.48	<1.09	<1.09	<1.09	<1.09
3436	<1.09	<1.09	1.87	2.84	3.62	<1.09	<1.09	<1.09	<1.09	1.48	<1.09	<1.09	<1.09
3439	<1.09	<1.09	<1.28	<1.28	2.45	2.06	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3447	<1.09	2.06	2.45	2.64	3.81	1.48	<1.09	<1.09	<1.09	<1.09	1.87	<1.09	<1.09
3456	<1.09	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3460	<1.09	<1.28	2.06	1.67	2.45	1.87	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3463	<1.09	<1.28	2.64	2.45	2.45	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3468	<1.09	2.45	2.45	2.64	5.17	<1.09	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3469	<1.09	1.48	<1.28	1.48	2.26	<1.28	2.64	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3472	<1.09	<1.28	2.06	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	1.87	<1.09	<1.09
3474	<1.09	1.87	<1.09	<1.28	<1.09	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3475	<1.09	2.26	3.42	4.59	3.81	3.23	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3477	<1.09	<1.09	2.45	1.48	3.03	<1.28	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3479	<1.09	1.48	<1.09	<1.28	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3485	<1.09	1.67	2.26	2.06	2.06	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3492	<1.09	2.26	3.03	4.4	4.78	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3497	<1.09	<1.28	1.67	1.67	2.45	<1.09	<1.09	<1.09	<1.09	<1.09	NC	<1.09	<1.09
3514	<1.09	<1.28	2.64	3.23	3.62	<1.09	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3515	<1.09	<1.28	<1.28	<1.09	2.45	1.87	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3518	<1.09	1.67	2.45	2.06	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
3524	<1.09	1.87	3.81	4.4	4.59	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09

*: All animals stopped virus shedding from Study Day 40 to end of study.
Data highlighted in yellow in the table indicates virus isolation titer ≥ 1.09 $\log_{10}TCID_{50}$. Sample is negative if < 1.09 $\log_{10}TCID_{50}$.
NC: Sample was not collected hence data not available for this animal on this day.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Bovine parainfluenza type 3 (PI_3) virus</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against respiratory disease caused by PI_3 virus</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in one (1) nostril</td></tr>
<tr><td>Study Animals</td><td>17 vaccinates, and 18 controls calves, 3 to 5 days-old and PI3 sero-negative [serum neutralizing (SN) antibody titer < 1:2]</td></tr>
<tr><td>Challenge Description</td><td>PI_3 virus administered 28 days after vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Calves were observed daily for 14 days following challenge. Nasal swabs for virus isolation were collected on the day before challenge and daily through the end of study (except day of challenge).</td></tr>
<tr><td>Results</td><td>Duration of shedding of PI_3 virus was evaluated.

<u>Duration of shedding in Days (5 number-summary):</u>

<table>
<tr><th>Treatment Group</th><th>Minimum</th><th>25th Percentile</th><th>Median</th><th>75th Percentile</th><th>Maximum</th></tr>
<tr><td>Controls</td><td>6</td><td>8.0</td><td>9.5</td><td>11.0</td><td>14</td></tr>
<tr><td>Vaccinates</td><td>3</td><td>4.0</td><td>5.0</td><td>6.0</td><td>14</td></tr>
</table>

See tables attached for individual animal shedding data.</td></tr>
<tr><td>USDA Approval Date</td><td>08/27/2014</td></tr>
</table>

Virus isolation on days post challenge in log $_{10}$ $TCID_{50}$/mL:

Animal ID	Day of study (Challenge was on Day 28)														
	27	29	30	31	32	33	34	35	36	37	38	39	40	41	42
CONTROLS															
5267	<1.09	3.42	3.81	4.78	5.95	5.37	3.81	2.26	1.48	<1.09	1.87	<1.28	<1.28	<1.09	<1.09
5268	<1.09	3.62	4.4	6.54	6.15	5.76	3.62	1.67	<1.28	<1.09	<1.28	<1.09	<1.09	<1.09	<1.09
5269	<1.09	3.62	3.81	5.17	6.54	4.98	3.81	1.87	1.48	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09
5272	<1.09	3.42	4.01	5.37	6.15	4.98	3.42	1.87	<1.28	1.48	<1.09	<1.09	<1.09	<1.09	<1.09
5278	<1.09	2.64	3.42	4.59	4.4	5.37	4.4	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	1.28
5279	<1.09	3.23	4.2	4.4	4.4	4.01	5.37	2.06	<1.09	1.67	<1.09	<1.09	<1.09	<1.09	<1.09
5281	<1.09	3.03	4.59	5.95	5.95	5.95	5.37	3.03	2.64	2.26	<1.09	<1.28	<1.09	<1.09	<1.09
5282	<1.09	3.23	4.2	4.59	5.37	4.59	4.4	3.03	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5288	<1.09	4.2	4.01	4.4	4.98	5.76	4.59	2.84	<1.28	1.67	1.67	1.67	<1.09	<1.28	<1.09
5289	<1.09	3.23	4.01	4.98	4.2	5.56	4.4	2.26	<1.09	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09
5290	<1.09	3.23	5.76	4.59	5.95	6.15	4.78	2.06	<1.09	1.48	3.03	<1.28	<1.09	<1.09	<1.09
5293	<1.09	3.42	3.81	4.01	4.98	4.4	4.01	2.06	1.87	<1.28	<1.09	<1.28	<1.09	<1.09	<1.09
5296	<1.09	2.26	3.62	2.84	3.81	5.76	4.59	3.62	1.48	<1.09	<1.09	<1.28	<1.09	<1.09	<1.09
5299	<1.09	2.26	3.23	6.15	5.95	6.34	5.37	3.03	<1.28	1.48	<1.09	<1.28	<1.09	<1.09	<1.09
5305	<1.09	2.45	3.03	4.2	6.73	4.59	4.59	2.06	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5306	<1.09	3.42	4.2	3.81	5.17	5.37	4.4	2.06	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5307	<1.09	3.42	4.98	4.78	5.76	5.76	3.62	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5308	<1.09	3.03	4.4	4.78	5.76	6.34	5.76	3.03	2.26	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
VACCINATES															
5270	<1.09	3.03	2.64	2.45	2.45	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5271	<1.09	2.64	3.03	4.2	4.01	3.42	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5273	<1.09	2.06	2.06	1.87	1.87	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5274	<1.09	2.45	2.45	3.03	3.23	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5276	<1.09	3.23	3.03	4.2	3.23	2.45	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5277	<1.09	2.64	2.45	3.23	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5284	<1.09	2.26	3.03	2.64	3.42	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5285	<1.09	3.62	1.87	1.87	2.06	3.23	2.64	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5286	<1.09	2.06	3.03	2.64	2.84	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5287	<1.09	2.64	3.42	4.78	5.17	2.84	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5291*	<1.09	1.87	2.06	2.06	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	-	-	-	-	-
5292	<1.09	<1.09	2.26	2.26	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5295	<1.09	2.45	2.64	3.03	2.26	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5300	<1.09	1.67	2.64	2.84	2.45	<1.28	<1.09	<1.28	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5302	<1.09	3.03	3.03	3.03	3.81	2.26	3.03	5.17	1.67	3.23	2.45	≥4.20	2.45	1.87	2.06
5303	<1.09	3.62	3.23	2.84	2.45	1.48	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09
5304	<1.09	3.42	3.23	3.62	4.2	1.67	1.87	1.67	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09	<1.09

Data highlighted in yellow in the table indicates virus isolation titer ≥ 1.09. Sample is negative if <1.09 $log_{10}TCID_{50}$

* Animal 5291 was (removed from the study on day 37 due to injured hock and bacterial nephritis) euthanized on day 37 following collection of nasal secretions

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Bovine Respiratory Syncytial Virus (BRSV)</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against respiratory disease caused by Bovine Respiratory Syncytial Virus (BRSV)</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in two (2) nostrils</td></tr>
<tr><td>Study Animals</td><td>19 vaccinates, and 10 control calves; 6 to 8-week-old Holstein calves and seronegative to BRSV (serum neutralizing antibody titer < 1:8)</td></tr>
<tr><td>Challenge Description</td><td>BRSV challenge 21 days after vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Animals were observed for 8 days post challenge. Mortality due to BRSV was monitored and lung-lesions were scored. Nasal swabs for virus isolation were collected before challenge and on study days 23 through 29.</td></tr>
<tr><td>Results</td><td>Animals were considered affected by BRSV disease if they developed cough, depression, dyspnea, increased respiratory rate and/or died post challenge. Mortality and Lung lesions were compared for efficacy.

<u>Post-challenge Mortality Rates:</u>

<table>
<tr><th>Treatment Group</th><th>Mortality</th><th>Percent Affected (%)</th></tr>
<tr><td>Controls</td><td>10/10</td><td>100</td></tr>
<tr><td>Vaccinates</td><td>0/19</td><td>0</td></tr>
</table>

The percent of lung that was abnormal (consolidated/lesion) was calculated for every animal.

<u>Percent of Lung Lesions (5-number summary):</u>

<table>
<tr><th>Treatment Group</th><th>Minimum</th><th>25th Percentile</th><th>Median</th><th>75th Percentile</th><th>Maximum</th></tr>
<tr><td>Controls</td><td>33.5</td><td>40.6</td><td>46.8</td><td>77.5</td><td>84.4</td></tr>
<tr><td>Vaccinates</td><td>0.3</td><td>1.1</td><td>2.5</td><td>13.2</td><td>35.6</td></tr>
</table>

See attached pages for individual raw data</td></tr>
<tr><td>USDA Approval Date</td><td>09/28/2009</td></tr>
</table>

Individual Mortality and Percent of Lung Lesion Results:

Treatment Group	Animal ID	Mortality	Percent of Lung Lesions
Controls	02	YES	47.60
	03	YES	40.55
	10	YES	46.01
	11	YES	84.36
	16	YES	33.53
	17	YES	75.88
	19	YES	81.17
	24	YES	45.85
	32	YES	77.50
	34	YES	35.45
Vaccinates	01	NO	8.60
	05	NO	13.24
	06	NO	0.26
	08	NO	1.99
	09	NO	21.94
	12	NO	11.48
	13	NO	6.27
	15	NO	0.48
	18	NO	1.13
	20	NO	1.50
	21	NO	0.30
	22	NO	12.11
	23	NO	0.60
	25	NO	16.14
	26	NO	1.08
	27	NO	35.55
	28	NO	19.65
	29	NO	2.51
	33	NO	1.06

The yellow highlighted cells indicate if the animals died/was euthanized

BRSV Disease: Cough

Treatment Group	Animal ID	Study Day (Challenge was on Day 21)								
		21	22	23	24	25	26	27	28	29
CONTROLS	02	0	0	0	0	0	0	0	-	-
	03	0	0	0	0	0	0	0	0	-
	10	0	0	0	0	1	1	0	-	-
	11	0	0	0	0	0	0	0	-	-
	16	0	0	0	0	0	0	0	-	-
	17	0	0	0	0	0	0	0	-	-
	19	0	0	0	0	0	0	-	-	-
	24	0	0	0	0	0	0	0	-	-
	32	0	0	0	0	0	1	0	0	-
	34	0	0	0	0	0	0	0	0	-
VACCINATES	01	0	0	0	0	0	0	0	0	0
	05	0	0	0	0	0	0	0	0	0
	06	0	0	0	0	0	0	0	0	0
	08	0	0	0	0	0	0	0	0	0
	09	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0
	23	0	0	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0
	27	0	0	0	0	0	0	0	0	0
	28	0	0	0	0	0	1	0	0	0
	29	0	0	0	0	0	0	0	0	0
	33	0	0	0	0	0	0	0	0	0

Clinical Score for Cough:
0 = <3 coughing episodes noticed during observation period; 1 = Coughing noticed 3+ times during observation period.
-: Some of the Control calves did not make it to the end of the challenge phase due to severe BRSV disease and were humanely euthanized based on the scoring for Dyspnea or respiratory effort.
The yellow highlighted cells indicate a score ≥ 1.

BRSV Disease: Depression

Treatment Group	Animal ID	Study Day (Challenge was on Day 21)								
		21	22	23	24	25	26	27	28	29
CONTROLS	02	0	0	0	0	0	0	0	-	-
	03	0	0	0	0	0	0	0	0	-
	10	0	0	0	0	0	0	1	-	-
	11	0	0	0	0	0	0	1	-	-
	16	0	0	0	0	0	0	1	-	-
	17	0	0	0	0	0	0	1	-	-
	19	0	0	0	0	0	0	-	-	-
	24	0	0	0	0	0	0	0	-	-
	32	0	0	0	0	0	0	0	0	-
	34	0	0	0	0	0	0	0	0	-
VACCINATES	01	0	0	0	0	0	0	0	0	0
	05	0	0	0	0	0	0	0	0	0
	06	0	0	0	0	0	0	0	0	0
	08	0	0	0	0	0	0	0	0	0
	09	0	0	0	0	0	0	0	0	0
	12	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0
	23	0	0	0	0	0	0	0	0	0
	25	0	0	0	1	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0
	27	0	0	0	0	0	0	0	0	0
	28	0	0	0	0	0	0	0	0	0
	29	0	0	0	0	0	0	0	0	0
	33	0	0	0	0	0	0	0	0	0

Clinical Score for Depression:
0= Normal. Alert, active, stands, moves and responds to stimuli quickly and steadily, shows continuous interest in surroundings; 1 = Mild. Lethargic and somnolent, stands, moves and responds to stimuli slowly and/or unsteadily, holds head low, lies down occasionally; 2 = Moderate. Tends to lie down frequently, lethargic and somnolent, stands, moves and responds to stimuli reluctantly and unsteadily, holds head low, staggers, shows little interest in surroundings; 3 = Severe. Recumbent or shows little or no response to stimuli or stands/moves with difficulty. Animal should be euthanized for humane reasons.
-: Some of the Control calves did not make it to the end of the challenge phase due to severe BRSV disease and were humanely euthanized based on the scoring for Dyspnea or respiratory effort.
The yellow highlighted cells indicate a score ≥ 1.

BRSV Disease: Dyspnea

Treatment Group	Animal ID	Study Day (Challenge was on Day 21)								
		21	22	23	24	25	26	27	28	29
CONTROLS	02	0	0	0	0	0	1	2	-	-
	03	0	0	0	0	0	0	2	2	-
	10	0	0	0	0	1	2	2	-	-
	11	0	1	0	0	1	2	3	-	-
	16	0	0	0	1	2	1	2	-	-
	17	0	0	0	0	2	3	3	-	-
	19	0	0	0	0	2	2	-	-	-
	24	0	0	0	0	0	1	2	-	-
	32	0	0	0	0	0	1	2	3	-
	34	0	0	0	0	0	0	2	2	-
VACCINATES	01	0	0	0	0	0	0	0	0	0
	05	0	0	0	0	0	0	0	0	0
	06	0	0	0	0	0	0	0	0	0
	08	0	0	0	0	0	0	0	0	0
	09	0	0	0	0	1	2	2	2	2
	12	0	0	0	0	0	0	0	0	0
	13	0	0	0	0	0	0	0	0	0
	15	0	0	0	0	0	0	0	0	0
	18	0	0	0	0	0	0	0	0	0
	20	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0
	23	0	0	0	0	0	0	0	0	0
	25	0	0	0	0	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0
	27	0	0	0	0	0	1	2	1	1
	28	0	0	0	0	0	1	0	0	0
	29	0	0	0	0	0	0	0	0	0
	33	0	0	0	0	0	0	0	0	0

Clinical Score for Dyspnea:
0 = Normal. Respirations are shallow and mostly thoracic (difficult to see at a distance of approximately 10 feet); 1 = Mild. Respirations are short and rapid, largely abdominal (easy to see at a distance of approximately 10 feet); 2 = Moderate. Respirations are labored and entirely abdominal; 3 = Severe. Respirations are very labored or animal grunts during breathing. Animals scored a "3" for 2 consecutive days should be euthanized for humane reasons.
-: Some of the Control calves did not make it to the end of the challenge phase due to severe BRSV disease and were humanely euthanized based on the scoring for Dyspnea or respiratory effort.
The yellow highlighted cells indicate a score ≥ 1.

BRSV Disease: Respiratory Rate

Treatment Group	Animal ID	Study Day (Challenge was on Day 21)								
		21	22	23	24	25	26	27	28	29
CONTROLS	02	0	1	0	1	1	3	3	-	-
	03	0	0	0	0	0	1	3	3	-
	10	0	0	0	1	2	3	3	-	-
	11	0	1	1	0	3	3	1	-	-
	16	0	0	1	2	3	3	3	-	-
	17	0	1	1	1	3	1	2	-	-
	19	0	0	1	1	3	3	-	-	-
	24	0	0	0	1	1	3	3	-	-
	32	0	0	0	0	0	2	3	1	-
	34	0	0	0	0	0	1	3	3	-
VACCINATES	01	0	0	0	0	0	0	0	0	0
	05	0	0	0	0	1	0	1	0	0
	06	0	0	0	0	0	0	0	0	0
	08	0	0	1	0	0	0	0	0	0
	09	0	1	1	1	1	2	2	2	1
	12	0	0	1	1	0	0	1	0	0
	13	0	0	0	0	0	0	0	0	0
	15	0	1	0	0	0	0	0	0	0
	18	0	0	1	1	1	0	0	0	0
	20	0	0	0	0	0	0	0	0	0
	21	0	0	0	0	0	0	0	0	0
	22	0	0	0	0	0	0	0	0	0
	23	0	1	0	1	1	0	0	0	0
	25	0	0	0	0	0	0	0	0	0
	26	0	0	0	0	0	0	0	0	0
	27	0	0	1	1	1	2	3	2	1
	28	0	1	1	1	0	2	1	1	0
	29	0	0	0	0	0	0	0	0	0
	33	0	0	0	1	0	0	0	0	0

Clinical Score for Respiratory Rate:
0= ≤ 44 breaths / minute; 1 = 45 – 64 breaths / minute; 2 = 65 – 80 breaths / minute; 3 = ≥ 81 breaths / minute...
Some of the Control calves did not make it to the end of the challenge phase due to severe BRSV disease and were humanely euthanized based on the scoring for Dyspnea or respiratory effort.
The yellow highlighted cells indicate a score ≥ 1.

<table>
<tr><td>Study Type</td><td>Efficacy</td></tr>
<tr><td>Pertaining to</td><td>Bovine Respiratory Syncytial Virus (BRSV)</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate efficacy against respiratory disease caused by BRSV.</td></tr>
<tr><td>Product Administration</td><td>One dose administered intranasally (IN) in one (1) nostril</td></tr>
<tr><td>Study Animals</td><td>Thirty, 3 to 9-day-old Holstein calves, susceptible to BRSV: 10 controls, 18 vaccinates</td></tr>
<tr><td>Challenge Description</td><td>BRSV challenge 49 and 57 days after vaccination</td></tr>
<tr><td>Interval observed after challenge</td><td>Animals were observed for 8 days post challenge.</td></tr>
<tr><td>Results</td><td>Animals were considered affected by BRSV disease if they died post challenge.

<u>Post-challenge Mortality Rates:</u>

<table>
<tr><th>Treatment Group</th><th>Mortality</th><th>Percent Affected (%)</th></tr>
<tr><td>Controls</td><td>9/10</td><td>90</td></tr>
<tr><td>Vaccinates</td><td>0/18</td><td>0</td></tr>
</table>

See attached pages for individual raw data</td></tr>
<tr><td>USDA Approval Date</td><td>11/27/2013</td></tr>
</table>

Individual Mortality Results:

Treatment Group	Animal ID	Mortality
Controls	10	YES
	11	YES
	13	YES
	16	YES
	20	YES
	22	YES
	25	YES
	31	YES
	9	YES
	5	NO
Vaccinates	1	NO
	14	NO
	15	NO
	17	NO
	19	NO
	2	NO
	23	NO
	28	NO
	30	NO
	33	NO
	34	NO
	35	NO
	36	NO
	4	NO
	6	NO
	8	NO
	3	NO
	12	NO

The yellow highlighted cells indicate mortality.

<table>
<tr><td>Study Type</td><td>Safety</td></tr>
<tr><td>Pertaining to</td><td>All Fractions</td></tr>
<tr><td>Study Purpose</td><td>Demonstrate safety under field conditions in minimum age, weaned and high-stress calves and pregnant cows</td></tr>
<tr><td>Product Administration</td><td>One dose administered Intra Nasally (IN)</td></tr>
<tr><td>Study Animals</td><td>A total of 1873 cattle (minimum age calves 0-8 days of age, 2-3 months of age, 6-12 months of age, high-stress stockers, and pregnant cattle in all three trimesters of pregnancy) were enrolled at 3 geographic locations. The animals were distributed as follows: 620 controls in one treatment group, and 1253 vaccinates in 2 treatment groups (two pre-licensing serials were used in the study).
<table>
<tr><th colspan="2" rowspan="2">Category</th><th rowspan="2">Controls</th><th colspan="2">Vaccinates</th><th rowspan="2">Total Number Enrolled</th><th rowspan="2">Total Number Completed study</th></tr>
<tr><th>Group 1</th><th>Group 2</th></tr>
<tr><td colspan="2">Minimum age calves (0-8 days)</td><td>108</td><td>106</td><td>106</td><td>320</td><td>316</td></tr>
<tr><td colspan="2">Calves (2-3 months)</td><td>52</td><td>54</td><td>54</td><td>160</td><td>160</td></tr>
<tr><td colspan="2">Calves (6-12 months)</td><td>52</td><td>54</td><td>54</td><td>160</td><td>160</td></tr>
<tr><td colspan="2">High-stress stockers (9 months)</td><td>100</td><td>100</td><td>100</td><td>300</td><td>292</td></tr>
<tr><td rowspan="3">Pregnant animals*</td><td>First trimester</td><td>104</td><td>104</td><td>104</td><td>312</td><td>312</td></tr>
<tr><td>Second trimester</td><td>102</td><td>104</td><td>106</td><td>312</td><td>312</td></tr>
<tr><td>Third trimester</td><td>102</td><td>104</td><td>103</td><td>309</td><td>309</td></tr>
<tr><td colspan="2">Total for All Groups</td><td>620</td><td>626</td><td>627</td><td>1873</td><td>1861</td></tr>
</table>
*Pregnant animals were selected based on fetal age and identified according to trimester of pregnancy: 1st trimester (fetal age ≤95 days), 2nd trimester (fetal age 96-190 days) and 3rd trimester (fetal age 191-285 days).</td></tr>
<tr><td>Challenge Description</td><td>N/A</td></tr>
<tr><td>Interval observed after vaccination</td><td>All animals were observed for any untoward local or systemic reactions within four hours post-vaccination and at least once daily from Study Days 0 through 28/29 for general health observations. During daily observations, pregnant animals were also monitored for any aborted fetuses. Pregnancy evaluations were done on Days 28 and 29.</td></tr>
</table>

Results

Number of Adverse Events (AEs) Across All Animal Categories			
AEs	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Number of AEs of Total Enrolled (%)	101 of 620 (16.3%)	118 of 626 (18.8%)	105 of 627 (16.7%)

Non-Pregnant Animals:

Number of Adverse Events per Animal Category and Treatment Groups			
Animal Categories	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Calves Minimum Age (0-8 days of age)	61	67	58
Calves 2-3 months of age	18	17	19
Calves 6-12 months of age	2	0	2
High Stress Stockers (9 months of age)	12	21	16

Type and Number of Adverse Events in Minimum Age Calves, 0-8 days of age			
Adverse Event	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Anorexia	0	1	0
Ataxia	0	0	1
Abdominal Pain	1	4	0
Otitis Media	0	2	1
Depression	15	18	12
Diarrhea	55	55	52
Nasal discharge	0	1	1
Pneumonia	1	0	3
Not Drinking	0	1	1
Dehydrated	0	0	1
Death	3	0	0

Type and Number of Adverse Events in 2 – 3-Month-old Calves			
Adverse Event	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Diarrhea	2	3	1
Pneumonia	14	16	15
Bloat	0	0	1
Otitis media	3	1	2

Type and Number of Adverse Events in 6 –12-Month-old Calves			
Adverse Event	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Corneal Edema	1	0	1
Conjunctivitis	1	0	0
Corneal Edema and Conjunctivitis	0	0	1
Cough	1	0	0

Type and Number of Adverse Events in High Stress Stockers			
Adverse Event	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
Pneumonia	12*	21*	15*
Lameness	0	0	1

* 1, 6 and 1 stocker calves in Controls, Group 1 and Group 2, respectively were removed from the study due to clinical diagnosis of severe pneumonia

Pregnant Animals:

Number of Adverse Events in Pregnant Cattle			
Trimester of Pregnancy	**Controls**	**Vaccinates**	
		Group 1	**Group 2**
1st	5	5	5
2nd	0	3	2
3rd	3	5	3

	Type and Number of Adverse Events in Pregnant Cattle **Adverse Event** / **Controls** / **Vaccinates** (**Group 1**, **Group 2**) Abnormal Behavior: 1 / 0 / 1 Abortion*: 1 / 4 / 1 Conjunctivitis: 2 / 0 / 2 Diarrhea: 1 / 0 / 0 Lameness: 3 / 9 / 4 Nasal Discharge: 0 / 0 / 1 Pneumonia: 0 / 0 / 1 *: The abortions occurred in all treatment groups at rates which do not detract from the safety of the vaccine. There were no apparent effects due to the vaccine administered to Group 1 and 2 as affirmed by licensee. There were no adverse events that were attributable to the administration of the tested product four hours after vaccination and throughout the study involving animals from all 3 treatment groups as affirmed by the licensee. No local or systemic reactions were observed.
USDA Approval Date	04/06/2010